Proceedings

Journal

OF THE

Michigan Schoolmasters' Club

AT THE

Forty-First Meeting

HELD IN

ANN ARBOR, March 29, 30, 31,

1906

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PROCEEDINGS

OF THE

MICHIGAN SCHOOLMASTERS' CLUB

FORTY-FIRST MEETING

HELD IN ANN ARBOR, MARCH 29, 30, 31, 1906

ANN ARBOR, MICHIGAN
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Michigan Schoolmasters' Club

PROCEEDINGS OF THE FORTY-FIRST MEETING, HELD AT ANN ARBOR, MARCH 29, 30, 31, 1906

EDITED BY THE SECRETARY

GENERAL MEETINGS

The forty-first meeting of the Michigan Schoolmasters' Club began on Thursday, March 29, with meetings of the classical, modern language, and physics and chemistry conferences. The general meetings were held on Friday and Saturday mornings in University Hall. Friday morning Professor John T. McManis, of the Western Normal School, read a paper on "The Educational Import of Modern Thought." Dr. Theodore de Laguna, of the university, was unable to give his paper on account of illness, but it was read by Professor George Rebec, of the university. The title of Mr. de Laguna's paper was "Evolution and Moral Education." President E. G. Lancaster, of Olivet College, read a paper entitled "The Nature of the Child." These three papers are published in this number of the proceedings.

On Friday afternoon at four o'clock President W. O. Thompson, of the Ohio State University, was to have given an address upon "The Meaning of Education," but was unable to do so on account of the severe illness of the governor of Ohio.

At five o'clock in the Barbour gymnasium the members of the club attended a basketball game and a gymnastic drill given by the young ladies of the university; and at 8 o'clock they listened to a concert given by Sousa and his band. Persons holding membership tickets were admitted free to these entertainments.

On Saturday morning Mr. Jesse Davis, of Detroit, read a paper upon "Over-pressure in High Schools," which showed that there is no over-pressure in the high schools whose work he had investigated.

Professor John Dewey, of Columbia University, gave an address upon "Self Activity in Education; Its Meaning and Conditions."

On Thursday evening at the close of the joint session of the classical and modern language conferences, an informal reception was held in the parlors of the Barbour gymnasium to enable teachers to meet the speakers, the officers of the club and the members of the Faculty of the University in the departments of Ancient and Modern Languages.

The program of the general meetings and of the different conferences of the club is given in full on page ——

The minutes of the business meeting and the new articles of association and by-laws may be found immediately following the papers.

THE EDUCATIONAL IMPORT OF MODERN THOUGHT

PROFESSOR JOHN T. MC MANIS, WESTERN NORMAL.

There is nothing more striking to even the casual observer of modern life than the machinery of industrial and business activities. Within the last forty or fifty years every line of industry has built up its own particular system. Moreover, the complications of these systems has grown so great that it takes a lifetime to master them, the consequence being that their effectiveness is greatly reduced, and the management of them is accompanied with enormous waste. But, extravagance is only a natural result of an effort to systematize on a large scale the output of industry. As it is now, every change in style of living or method of finishing products leaves the useless and surplus remnants to be thrown aside to make room for new installments.

Within the realm of the various distinctively social institutions, one also finds evidence of wheels and levers and pulleys. Again one finds here that each department has its system. Just as in the industrial world there is little hope for the individual outside the limits of the corporations, so with social institutions, there is small chance for independent activity. Even in this twentieth century, with its rapid strides in freedom of thought and action, our beliefs are still so largely pinned to organization, to prevailing custom, that we can scarcely tolerate the *independent,* and we tend to look with suspicion or commiseration on the one who refuses to co-operate with the powers that be.

The educational system is bound up in this same set of forces. For the most part, it is machinery that moves the schools. Systematization and organization are the pre-requisites for a modicum of success in every educational effort. The school that is not controlled by a system is of necessity regarded as inefficient in its cultural influence. Before the institution can begin to work, it must be completely supplied with costly equipment and large endowment. Its patronage of wealth and its dependence on advertisement are systems, refined beyond the ken of the ordinary individual. School-room practice is tied up in the interminable complexity of this system. The subjects to be taught, the pages to be covered, the exact time limits for recitations, the plans and devices, all these fit into the whole like cogs, and turn in their exact order in the great machine. The concern is oiled, not always by professionally prepared lubricants, but, too often, by the greasy dope of political ethics.

Thus it is that the Siren's voice in modern America is not the beckoning of some far-off, shadowy unreality, or vague ideal, luring on to high endeavor, but, is rather the rattle and bang of the business

machine, the buzz and grind of wheels, the screech of the twentieth century limited, or the loud sounding notoriety in the struggle for advertisement. The reduction of everything to a beautifully working system and an exact order, forms the controlling passion of men in every walk of life. The modern utilitarian mind abhors chaos as nature does a vacuum.

However, there is no reason for assuming that this passion is the only or final and dominating force in the modern world. Its sway is not so complete as might be judged from what I have said, for if it were, there would be slight need for our efforts at improvement. The tendency in the direction of building up organizations is symptomatic of forces of more vital import than is shown on the surface of things. No one doubts that the reduction of the various phases of life to complete order and system, leaves still the largest part of the whole unresolved. We are still face to face with the problem that living is the business of life, for which, systems and organizations form only the tools. One needs must listen more sharply to catch the meaning of this chaotic order and hubbub.

In his efforts to detect this meaning, the observer is struck with the fact that these confused attempts at organization and sysematization point consistently to certain more or less clearly defined pre-suppositions which form the controlling concepts of modern life. It is with these concepts and their bearing upon the educational practice in the elementary schools that I am concerned. What I shall say on the theoretical side is more or less common opinion among those who make any pretense to thought, and, consequently, it is not on this side that my contribution is offered; but, I am rather interested in the bearing that some of these most commonly accepted ideas have upon school work, knowing full well, that, however glibly we speak of these things in books and educational conventions, there is still a wide divergence between them and the actual teaching process. Not that, of course, we are not making progress in control and intelligence, but that there is much that remains to be done in the school room, in order to bring these to a higher plane.

Of these pre-suppositions there are only two that I shall have time to discuss, however desirable it might be to go into detail in many other directions. Moreover, the educational relationships I have in mind to make must necessarily be brief, and yet, I hope their bearing may be typical of many other principles. These two pre-suppositions are the underlying and basic elements in democracy and science, and should, therefore, have a significant place in all educational procedure.

In the first place, then, and deeper than the American's faith in his machinery, lies his over-weening confidence in himself and his capacity to do that whereunto he has set his hand. At once, it is clear that it is out of just this belief in himself that the machinery and

organization spring, for the latter are in fact but the lengthening of his own reach. His faith in self is not second to that in his system, and this naive and often undefined appreciation of his own power usually grows in proportion as his perspective of life and history narrows. Even though the individual may fall victim to the creations of his hands and brain, he blames circumstances and not himself.

From such a feeling of his own significance in the order of things, man brings upon himself the conflict, which is present in all stages and phases of civilization, between his private demands and the general institutional organizations, and which we are even now facing in some of its most acute forms. From this same feeling of the worth of man and his activities, there arises, too, the salvation of the individual from the ultimate domination of the shackles of institutionalism. Man knows himself greater than the work of his own hands, and knows, too, that when it is necessary, he can set himself against these and destroy them. He can refuse to be crushed by the machines he has builded, and, though it may take time, even those institutions, hoary with sacred traditions, may fall beneath his iconoclastic energy. The common man does not long hesitate, when the need is his own hearth to use the accumulations of the ages for firewood. Between the inherited expressions of the processes of life, made uniform by the struggle of ages, and the variations in individual conditions and demands, there is always this friction and need of reorganization. History is a record of the periodic return to valuations defined in terms of human personality; and this is what makes it true that the content of our concepts of worth must finally consist in the sweat and blood of mankind.

This faith in the ultimate worth of the individual finds its highest expression in democracy. Consequently, it is true that, while on the face of affairs we seem to be dominated by organization, after all, the belief in the integrity and significance of the individual lies deeper and farther back than the system. But, as yet, we have not been willing to carry out into many fields the logical implications of democracy. The full meaning of the term is not possible of apprehension till each aspect of the maze of experience is given the same chance as any other to demonstrate its worth to the whole. If this attitude were taken toward democracy, each avenue of life would have applied to it those standards which are now significant in but few phases of activity. However, it must not be supposed that the development of the full worth of the individual through democracy carries with it an inevitable destruction of the institutional organizations. On the contrary, these institutions are only thus given their proper place as means of interpreting man to himself and of carrying into effect his needs and motives. Institutions in this way, become not ultimate ends to be attained, but methods by which each succeeding generation attains a more economical and efficient form for dealing with its problems of

life. Democracy in its last analysis consists in giving to each one the largest possible control of his activities in light of the common inheritance of mankind. Moreover, the attainment of an efficient democratic organization is possible only through a firm faith in the ultimate significance of the individual activities and thoughts as the goal of humanity.

One finds himself beset by many startling obstacles when he undertakes to discover this faith in the integrity of the demands of children in the schools, and he is shortly convinced that the most palpable fact about it is its absence. The treatment of youth in elementary school practice does not follow this commonplace of modern thought. The emphasis falls upon mere uniformity in the classification and teaching of pupils in the lower grades. School furniture and apparatus, uniform desks and seats, books and supplies, are all made upon the assumption of unvarying likeness in the processes of learning and attainment of results. The monotony of a dead level controls the assignment of lessons and the recitation from the common page, with equal emphasis on all points for all individuals. These regulations are only the merest excuse for democracy and are based on a complete misconception of the problem. The schoolroom is not now in a position to allow each individual to be determined in his activity in terms of what he can contribute to the common product of his own group. In its most vital sense this emphasis upon uniformity is the most insidious agency in destroying that faith in the power of the individual pupil to initiate and control his own attitude with reference to the most fundamental principles of society, which is, after all, the highest meaning of democracy. But again, we have our conflict between the general social demands and the personal needs; and so long as we persist in either disregarding one or the other, or, in arbitrarily setting them over against each other from an external point of view; and so long as we fail to recognize and employ in schoolroom practice the unity in the fundamental processes of human life and endeavor on the one hand, and the natural and vital variations of individuals on the other, just so long must our control present this wavering back and forth between anarchy and absolute sway of mere authority.

But, I am told, the schools are already organized upon the basis of just this recognition of democratic principles. In answer, I would say, in the first place, that there is a growing appreciation in the schoolroom of this point of view, and that the bright spots in our country where this is practiced are increasing in number; but, in the second place, such spots stand out because of their rareness as the work of choice teaching spirits. Further than this, the rank and file of our common schools are not proceeding upon such a basis, and, in many cases, intelligent and conscientious teachers are prevented from doing so on account of the effectiveness of the machinery of organiza-

tion and supervision. Simply because a school has manual training or nature study and other modern facilities in its curriculum is no prima facie evidence that the actual work has been organized under new concepts and is being carried on with a full appreciation of the meaning of these subjects. On the other hand, I may be accused of advocating rank individualism in the treatment of children, but it need only be recalled that I have thrown my emphasis for the determination of the conduct of the individual upon the general social body of which he constitutes an active and participating factor, to see that this fear is groundless.

If space permitted, I should like to show that these principles are true, not only for the pupils of the schools, but, in the same imperative sense, for those who teach these pupils. The teacher has the same right to demand that her relation to the whole be determined by the vital principles of democracy as any other individual, and where this is not recognized she must continue to give only partial obedience to the organization to which she is bound by superficial considerations. Our normal schools still continue to inculcate this superficial conformity to prescribed and empirical practice, the pattern for which is set without reference to a grasp of the controlling concepts in the situation.

But, alongside the faith in the ultimate worth of the individual stands a second as significant assumption as that of democracy, viz., a faith in the realness of the things which man handles and his method of dealing with them. This forms the second of the pre-suppositions toward which modern organizational activity points, which I wish to discuss in relation to educational practice. It is not merely a belief in the worth of the individual which characterizes our American thought, even though this forms one of the strongest factors in our civilization; but a like valuation and prize is set upon the things with which man comes in contact. The reality of the facts which answer the demands of his organism is unquestioned. In spite of the idealistic tendnecies of the present, there is prevalent a naturalistic attitude and naive acceptance of things and forces as they seem to be and as they can be used in the practical activities and purposes of life. The scientist and man of affairs both take facts for granted and build their world accordingly. Science is only possible on this assumption, for in no other way could the things one handles and investigates and uses have significance or mean anything to human activity. Faith in the validity of the processes of experience as ultimate tests of reality, forms, therefore, a fundamental postulate of modern thought; and the individual who throws over his reliance upon empirical standards and methods renders himself impotent to interpret the meanings of this thought.

Granting the commonplace of this statement in provinces where original investigations are carried on and where constructive activities

are encouraged, there still remains the field of early education, the common schools, where it has no such acceptance. The controlling practice of elementary education continues to be that, opposed by men like Rousseau and Froebel, of a prescriptive and external sort, and not that founded on the principles of modern science. The interests of the child and his capability of judging values for himself and others are persistently disregarded. The result is that the material must all be given the child, and habits must first be fastened on him by an external application, before he is able to become self-active. Locke went over this ground very thoroughly from his John Bull's point of view long ago, and his treatment would have satisfied conditions, providing child mind began life as an "empty cabinet" to be filled. But, since it is true that life begins with a decidedly complex organism to be satisfied through action and reaction, this formulation is far too simple to be adequate in the concrete. Every step in the satisfaction of the demand for experience on the part of the organism is by the nature of the case a balancing and testing of forces, and consequently must go on in the form of more or less hazardous experimentation. The child life from the start manifests the hunger and energy requisite to the demands of larger or smaller proportion, as age advances; and these manifestations present the same method that life has always used and that the scientist now uses in the investigation of his problems. This is not a contention for an education which employs the same slow process as that used by the race. Without doubt, we are able to take advantage of many things accomplished by civilization and make much more rapid development than ever before; but the disregard of the method by which these steps have been made must bring failure to our efforts to produce sane and strong character. The birthright of every man is this primitive and immediate struggle with the elemental factors that have formed the race, and the same sort of appreciations and intellectual valuations that have arisen from direct contact with the situations typical of his own stage of growth. Moreover, it is out of his experience in such a contact as this that there must grow the structure of civilizaiton, which too often we have attempted to impose *ab extra*.

Again I must repeat, that however much there may be of the commonplace in this proposition as a topic of educational or scientific discussion, there is far from common, or even limited, acceptance or recognition of it in the schools. I am confronted almost daily with the fact that in common practice the child's efforts and processes and evaluations are discredited, and for them are substituted, by a kind of artificial grafting, objective and foreign interests and methods. Faith in the power of the child to find and know reality, when he is placed in the presence of social and personal demands and needs, is too generally wanting. It is in the school that there is need of the appreciation of the fact that the mere acquisition of material, no matter how

scientifically arranged, can never take the place of a live experience with people and things and the resolution of this experience in terms of the child's own history. After all, it must fall to the teacher to bring the child to an appreciation of his responsibility for intelligent participation in the social functions.

If we accept this statement, then, that education of any importance must finally rest back on experience of an elemental and direct type, it follows that we must utilize as many of the various demands of child nature as possible within the limitations of the school. The earlier we utilize the initiative and self-dependence of the child the sooner there is given stability to the whole experience process, for he cannot proceed without organizing what he has already attained. The presentation of concrete situations that require the reorganization of what is learned will relieve us of the educational practice which makes its principal aim the inculcation of facts bearing no direct relation to the child's experience. The utilization of the demands of experience would change the character of the work, e. g., in geography, by giving them an organic connection to the life of the individual. The complaints which we all make of the poor preparatory work of students coming from the lower schools would cease if we could once realize in our practice that education is a more vital process than merely imparting information; that the human organism is an active, appreciative structure, builded on the same plan and seeking the same ends in large measure that the race has sought; and, therefore, having a method and integrity that can be relied on to reach worthy results.

But we are told that the school cannot take into consideration the entire scope of the child's experience, that the school has always been compelled to limit itself to particular and specialized forms of activity. Even though the life of the individual in a larger sense is the true educational material, yet, according to tradition, the school must necessarily leave aside the loves and hates, the ambitions and appreciations, the labors directed to practical needs, and the contacts with larger and fuller reality as things outside its realm. We are made to believe that the school can take only those values for its function which have already been established by rationalistic or reflective activity. In spite of the fact that there are other and different forms of experience of as great importance as merely the intellectual kind, these have been and are persistently disregarded. The attitude of the child, the appreciation, the moral sense, the motor skill, and the sympathetic insight, while they cannot be taken account of in terms of percentages on examinations, are still the very heart of the meaning of life. A scientific treatment of these different forms demands that they shall be given full credit for their own peculiar contributions to the significant reality of the normal human being.

Now, if we recognize that there are these many modes of experiencing, and that they are alike worthy and carry with them their own

values, even though the school has not hitherto provided for them in its formal plans, it is all the more imperative, if we are expecting to advance our work, that we should consider them as legitimate phases of the educational function. Although every age may be thought in some respect a transitional one, there never was a time when we were in greater need of making new definitions of education than the present, and of enlarging its scope so as to take into account the entire social context of child life.

From this point of view the fundamental problem now comes to be how to construct from these varied forms of experience, types or units of valuation that can be used in a practical way in teaching. In light of these units the teacher can measure with some assurance values that cannot now be estimated because our only standards are intellectual ones. It should be possible to estimate the pleasure—pain—arising from a given procedure, the degree of manual skill coming from specific work, or the practical utility in given exercises in terms of their relation to the larger fields to which they lead.

In the development of educational units for the measurement of these various forms of experience, it is necessary, in the first place, to get rid of some ideas that have clogged the teaching process for centuries. It should be made clear at once that it is not possible to make one form of experience stand wholly for the work of other forms. If the play of children is educative it is not merely educative in terms of arithmetic, nor can the educational value of manual training be given in terms of Latin composition. The norm or standard of reality in one line of conduct cannot be generalized into a norm for all other forms of conduct, for in every case it is necessary to take into consideration the historic context out of which and for which this norm arose. Our principal difficulty has come over and over again in trying to make one subject stand as the test for the value of other subjects; just as, in many places, arithmetic has been the touchstone by which both students and subjects have been compelled to yield all their possibilities to the magic power of this convenient instrument. But the impotence of a standard of mathematics in measuring qualities of energy and ambition, likes or dislikes, and personal interests, has been proven in practically every field of educational activity.

Again, in the formation of norms or standards by which to estimate the educational value of the different forms of experience, it is necessary that we proceed upon lines laid down by science and common sense. A thing shall be estimated in so far as possible for what it is itself worth, and worth, in turn, takes into consideration the complete social scale of activities, and not some limited phase of these. More than anything else in educational thought, we are in need of a procedure that gives definite and positive concepts of educational values. We are overburdened with educational opinions, and we need simple, direct and constructive standards, tested by the laboratory from data

found in actual conditions. Moreover, until there is applied to common school activity some form of scientific estimate and accurate measurement in a large and comprehensive way, the educational thought and procedure will be dependent upon these assertive formulations. In place of mere opinion and political or religious prejudice as guides, education needs carefully organized and developed concepts. Our normal schools and university departments of education must stand more as laboratories for the investigation of these problems in school practice, and for the collaboration of the results of these investigations on a large and usable scale, rather than for the doling out of classroom-made theories and artificial practice-school technique. We need to be able to show in a practical and definite way that manual training has, or has not, a specific value, that writing has a peculiar place, and so on through the list, and that each one of these values belongs to the subject, considered in the light of its relation to the total experience of the individual. The child that gains experience through æsthetic appreciation, or through constructive motor sources, deserves as careful and accurate treatment as any other, for he may have as vital hold on reality as the child with a precocious intellectual grasp on details. All ways of reaching reality are equally true ways, and we need to be able to judge the value of these accurately. Art, nature study, industrial activity, are to be estimated by their power to bring the child into sympathetic and constructive relation with the whole life of which he forms a part. Strange as it may seem, we have not been willing to grant the worth for formal educational activity to such a thing as the plain ordinary *use* in a given piece of work, or the happy and radiant satisfaction coming from another. Eighteenth centuryism, of the sort John Stuart Mill was given, discounts every phase of experience which cannot be developed as note-book pabulum or examination facts, and this same spirit is to be seen today in many different forms throughout our school system.

The selection of norms for the significant modes of experience means, among other things, that we are determining the content of the course of study. Whatever else this may contain, it should cover, as our best courses do today, the possible typical forms of experience. The difficulty is not so much in selecting the material for a curriculum, as it is in opening up avenues in this for different individuals and holding each responsible for the truth and meaning he is able to reach through it. In general, two principles can be derived from the point of view we have taken which help in the choice of subject-matter for the curriculum. The first of these involves the *immediate* experience value of educative material to the child in his contact with it. We cannot expect the subject to have much weight with the child if its value is pushed too far into the future, for it thus loses its immediate meaning to the organism and has no application to the present need. This has too often been the difficulty with our courses of study, for

they took for granted the fact that education was wholly a preparation for adult life, and there was no need that it should have any significant value to the child, as a child. In emphasizing the immediate use to the individual of any given material, we are not overlooking the fact that this use is determined by his social relations, a consideration necessary to give consistency to the course. The second principle involves the historic aspect of the child's life. The material of instruction is determined by the child's place in terms of the race development and his own degree of individual advancement in the scale of growth. On the basis of this principle, every phase of educational material and activity looks toward a larger and more complete future of experience, and a more intelligent control of this experience than that given by the mere satisfaction of the immediate end. It is impossible to go into the full bearing of this selection of subject-matter at this point; and, it must therefore, suffice to say in summary, that the material should possess the greatest flexibility, and the details should be left to the individual needs and variations, although the main trend must be fixed by more comprehensive social demands.

The course of study and educational practice as determined on these principles furnish the possibility of experience in many forms. It is not necessary to live on bread alone, when the world is full of sunshine and air and water and other equally useful things. Likewise, it is not necessary to live on realities of intellectual formulation alone, when there are other worlds of significant reality about us. Reflective and rational nutrition gets its value for the organism in an indirect way at best, and, therefore, must be administered only as the system has taken more organic and substantial foods, those of an elemental and concrete sort. In other words, intellectual processes are secondary and derivative processes. They are neither initial nor final. Living beings got experience of a vital sort, very probably, many ages before there was developed the machinery for carrying on reflective functions.

The initial stage of experience is activity. The crude and uncoordinated struggle for existence under conditions of stress, attains its end or not as chance may direct. The end for which these reactions are set up lies in the needs of the organism, and the impulse and instinct serve to bring about relationships between this organism and a larger world, and the satisfaction of these relationships, in turn, sets up still more complex processes. Furthermore, this form of action and reaction, while not reflective in any appreciable degree, serves the purpose of bringing about practical results. A large share of all our acts owes nothing more to intellectual processes than these crude, naive and impulsive forms of conduct. So long, indeed, as conditions remain of a determinate and stable sort, this crude form of endeavor fulfills the demands of life as well as any other.

On the other hand, the highest reaches of experience are not of the reflective processes. Here again, conduct constitutes the funda-

mental characteristic, but now, it is conduct with a more definite viewpoint and a more highly co-ordinated structure, and the individual is certain of his direction. The æsthetic and ethical appreciations reach deeper into the meaning of life than can be stated in reflective terms, yet their content and import appeal so strongly to human consciousness that we act upon this appeal in a thoroughly confident manner. The vague longing and aspiration are likewise implicity trusted, though hardly defined. Art, after all, most definitely universalizes just these appeals, and shows us that conduct constitutes finally the highest of the arts.

Between activity of the crude and undefined sort, and conduct in this highest form, there lies the phase of experience which we name the intellectual type. Its processes form an intermediate and connecting link between the other two. It formulates and estimates the crude experiences, and stands for many possible forms of reactions under given conditions. Since it is out of these crude and concrete activities that the thought process arises, it is at once clear, that the use of the abstract intellectual element as the beginning and end of education is taking it out of its true relations and making it an end in itself. The generalization of this process forms the basis for the dogma of formal discipline, of which we have heard so much in recent years.

Let it not be supposed that I am trying to minimize the place of reason in experience or in education; on the contrary, I would give it the highest cultivation which I possibly could. But, the point is, that it is just one form of the experience process, that it has its own particular limits, function and import; and that it has no more right to stand as the ultimate test of values, in general, than any other form, except for those facts which belong to the distinctively intellectual type.

In almost every discussion of the cultural or other values of this, that and the other subject, the argument is invariably thrown back on this one-sided intellectual basis. Greek and Latin, in secondary and higher institutions, are the greatest cultural subjects, if culture be defined in terms of these subjects themselves or some others like reflective norms. Given this eighteenth century attitude of formal intellectualism and no other estimate can be placed upon such subjects, and we are forever stopped from developing a culture based upon modern science and democratic ideals. Worst of all, this worship at the shrine of particular subjects of the intellectual type, represents the cultural attitude of a society and civilization built on slavery, and, consequently, can never represent more than a partial valuation of life processes.

There are many equally true modes of experiencing reality and our standards of value must take this fact into consideration. Culture, e. g., represents the outlook along any of these approaches to the world's work, and represents, furthermore, the appreciation of relationships to humanity and nature and the forces that work through them. Culture

is only possible in democracy, and democracy is only possible under the fundamental conception of the validity and worth of human endeavor. Life is worth while, and therefore, the instrumentalities through which life works and moves are worth while. From this point of view, each subject has its own cultural value to be estimated in terms of its own type of experience, manual labor as well as any other form. How much outlook is there in what one does; what appreciation does it foster, and finally, what can be done with it?—these are the questions which must be answered in giving cultural valuation to educational material. When once our psychology thoroughly rids us of the hold of formal discipline, we shall be able to place experiences upon their own distinctive merits; and then it will be found that, under the sway of democratic and scientific education and thought, each educational activity serves a clearly defined function, and all finally converge at the common point of sane conduct and intelligent appreciation.

EVOLUTION AND MORAL EDUCATION

DR. THEODORE DE LAGUNA, UNIVERSITY OF MICHIGAN

Whatever separation may ever have existed between the sciences of morals and of education, there was once a time when a dividing line could scarcely be imagined between them—when the fundamental and engrossing question of ethics was: *Is virtue something that can be taught?* and when the all-important problem of pedagogy was: *How shall virtue be taught?* This, as we all know, was at the birth of the two sciences in ancient Greece. Those very teachers, the sophists, who by the novelty both of the subject-matter and of the method of their disciplines had forced educational problems upon the attention of the Greek people, were also the men, who, by their assaults upon the traditional morality, had made a re-establishment of fundamental ethical conceptions the most pressing need of society.

Since the age of Plato, the connection between moral and educational science has never been so close as it is today. Within the last fifty years the evolutionary conception of morals has given rise to problems substantially the same as those of the *Meno* and the *Protagoras,* and, as I believe, their treatment has led to something very like the ancient solution. To point out this analogy, and to show that the most reasonable conclusions of evolutionary ethics with regard to the nature and limits of moral education are substantially identical with the Platonic theory of the subject, will be the object of these remarks.

Plato's principal addition to the theory of ethics, so far as that

directly bears upon moral education, is contained, curiously enough, in his notion of philosophical method, or *dialectic.* Dialectic, as you may remember, is his general term for the process by which the human mind advances to larger and larger conceptions of the nature of reality. It is what he somewhere calls the method of successive hypotheses. A thinker begins by accepting for what it may be worth some more or less plausible conception of reality, and then proceeds to carry this conception out to its extreme logical consequences in every possible direction. In one direction or another these consequences are found to contain some self-contradiction, which prevents their being accepted, and which thus points back to some necessary modification of the original hypothesis out of which the self-contradictory conclusions have come. When this hypothesis has been modified in the manner thus indicated, the same process is repeated. Starting from the modified hypothesis, its extreme consequences are followed out in every possible direction; somewhere a self-contradiction emerges; the hypothesis has again to be modified accordingly; and so on without end. I say "without end"; and yet Plato himself believed that there was an end—a sublime and perfect thought, which should comprehend the inmost essence of all things, and which should suffice to explain the universe to whatsoever mind should attain to it.

Perhaps we may have seemed to wander far away from the subject of moral education; for what has the logical method of the speculative philosopher to do with the process of growth by which a child or a man becomes virtuous? But Plato's doctrine is precisely that the two processes are identical, that *moral strength is dialetic* in exactly the sense which we have just defined; and one of the names which Plato attaches to that most perfect conception which lies at the goal of speculation is simply the *Good* or the *Idea of the Good.* According to him, then, the only way for us to advance in knowledge of the good is to comprehend to the uttermost the imperfect conceptions of life which we now possess. Then only will we be aware precisely wherein their imperfections lie and thus be able to replace them with broader and more satisfactory conceptions. That is why, even as Socrates maintained, the knowledge of the good can indeed be taught, and yet cannot be imparted as so much information. The child or the man must reach it by his own self-criticism, and the only way in which the teacher can aid him is by the directing of his attention to this or that aspect of his conduct which needs criticism. But the criticism itself must proceed from the pupil and not from the teacher; it must be the expression of his own experience and reasoned conviction. Otherwise it is of no real account; it is mere prejudice or opinion, even though it may chance to be correct; it is not true knoweldge. And knowledge, for Plato as for Socrates, is, as you will remember, the source of all virtue.

Now will it be thought an exaggeration if I say that the essence

of the best recent thought on moral education can be summed up in the single Platonic formula, "The acquirement of virtue is dialectic"? That, at any rate, is what I intend to maintain. To be sure, the meaning which we shall have to read into the term *dialectic* must needs be a somewhat changed one. We shall have to allow the emotional side of human nature a much larger share in the process. And yet after all, when agreements and differences are balanced up, I fancy that we shall find ourselves in hearty accord with the old Greek master.

Like almost all the other branches of mental science, the theory of moral development dates a new beginning from the publication of Darwin's work on the "Origin of Species." It was not so much that any of the particular facts that he brought out were of direct use to the moralist or the educator; but he gave to the world of thought certain new points of view, certain new ways of looking at things, that could not fail to lead to important observations.

It must be admitted that the moral theories which were at first connected with Darwinism, were very crude affairs indeed. They were in great part the work of hasty and ill-balanced thinkers, who had perhaps never really mastered the full meaning of Darwin's principles even within the biological realm to which he had applied them—to say nothing of being competent to extend those principles to other realms of investigation and give them in each case the modifications which they required. Or they were the work of professional biologists who had only—as we may say—an amateur interest in ethics, but who conceived that the recent discoveries in their own science had given them a gospel to preach to the rest of the benighted world. It may safely be said that nothing of any permanent value has come to us from the evolutionary ethics of that period. Perhaps, however, the same is to be said of the pioneers in almost every field of investigation; and perhaps, too, we owe a larger debt than at first sight appears, to the evolutionists of the sixties and seventies; since, after all, it was as a result of their misguided disputations that the clearer conceptions which we now possess came finally into view.

As Darwin's main problem had been the origin of species, and the development of the individual organism had been a matter of interest only in so far as it could throw light upon the history of the species—so for the early students of ethical evolution, the all-absorbing problem was the origin of moral sentiments in the human race; and the phenomena which attend the rise of those sentiments in the individual child were not considered to be of anything like the same direct importance for science. Moreover, biological conceptions were in the air and ruled every one's thinking. The moral sentiments were treated as *instincts,* and were considered to be of very much the same nature and origin as the animal instincts of self-defense and protection of offspring. As a matter of fact, a sentiment and an instinct are about as far removed from each other as any two mental or psychophysical

phenomena can very well be; but in the sixties and seventies this was not so well known as it is to-day. And so the problem of moral evolution was regarded as the problem of the origin of a certain class of human instincts, which, like other instincts, had been acquired by natural selection, and were preserved from generation to generation by being passed on from parent to child in the shape of a peculiar congenital disposition of the nervous organism. The child, that is to say, was supposed to inherit from its parents the distinction—or a tendency to draw the distinction—between temperance and intemperance, in the same way that the puppy inherits from its parents a tendency to bury in the ground a bone for which he has no present use. And that, as we shall see, is why the phenomena of the development of morality in the particular child's mind were not supposed to be of very great direct significance for science.

This point is of considerable importance for our present purposes, and will repay a somewhat extended examination. We are all familiar with the so-called *theory of recapitulation*—the doctrine that the individual organism in the course of its development recapitulates the whole process of evolution by which the type of its species changed from a one-celled speck of protoplasm to the complicated structure which it is to-day. Now this theory or law, as you may be pleased to call it, has one very obvious limitation—namely, that the individual development of which it speaks is simply the development of *inherited* characteristics, that is to say, of inherited structures and functions; the theory has nothing whatsoever to do with development in so far as that involves the modification of inherited characteristics or the acquirement of new ones. The creeping instinct which a baby displays some time in the course of his first year is a congenital characteristic, inherited in the form of a peculiar nervous and physical structure; and according to the recapitulation theory it is probable that this creeping points back, somewhat vaguely, to a mode of locomotion which the ancestors of our species practiced before the function of walking on two legs was evolved. Now, to take an extreme instance on the other side, consider the playing of the violin. That is obviously an acquired function; it has to be separately learned by each individual who wishes to have the accomplishment. He needs, it is true, a certain basis of inherited capacity to work upon; he must have, as we say, some degree of musical talent as well as of manual dexterity at the outset; but with all the talent and all the dexterity in the world, no one can play the violin without first learning how. Now my point is that with this acquirement of a new function, this "learinng how," the biological theory of recapitulation has absolutely nothing to do. There may, indeed, be an analogous law affecting acquired characteristics, but if there be such it must rest upon its own evidence; the facts of embryonic recapitulation can give it not the least support.

Let us note, then, some of the consequences which we should have to draw from the old asssumption that moral sentiments are instinctive. We should have to say, in brief, that they are a part of the congenital characteristics of the race transmitted from parent to child, not by education but by physiological heredity, appearing in each child at a fixed time and in a fixed order, determined not by any logical or psychological connection, but simply by the order of their first appearance in the history of the species.[1] And that—to get back to the question from which we started—is why, wrom this point of view, the development of the moral sentiments in the individual child was almost inevitably regarded as of only secondary importance. It simply had no significance in itself at all. It merely pointed back to the order in which moral sentiments had been acquired by the race.

Meanwhile some very excellent work was being done in the study of the development of ethical standards, not in individual men, but in societies; while the moral education of the child was still so grossly misunderstood, valuable light was being thrown upon the moral education of the race. The starting point of this investigation was a sort of modified utilitarianism. Utilitarianism, as we know, is the ethical theory, according to which the end of moral conduct is the "greatest happiness of the greatest number"; i. e., the goodness or badness of an act means its tendency to increase or decrease the happiness of all the men affected by the act. Now the happiness of men is a very difficult matter to investigate, and an algebraic sum of the pleasures and pains of a great multitude of men is practically impossible to compute. So it occurred to various thinkers to substitute for the conception of the greatest happiness of the greatest number, that of the health or well-being of society. Health, of course, is a biological term, and the expression implied a far-reaching analogy between a society of men and a biological organism. The health of a society, like the health of a plant or animal, meant the proper harmonious functioning of all its parts; and it was pointed out that such a condition of affairs in a society was certainly the most important condition for our maintenance of the greatest possible happiness among its members. The analogy of the social organism, like all other suggestive analogies, had its period of usefulness and then fell into neglect as its various points of inadequacy came to light; but while it lasted it served as the basis for those studies in moral evolution, the results of which I shall now attempt to put before you.

If one examines in detail the various virtues and duties which common sense usually recognizes, one readily perceives that these virtues and the performance of these duties constitute the most essentian conditions of social prosperity. Without a certain measure of wisdom the affairs of the commonwealth could not be conducted; with-

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[1]As modified, to be sure, by more recent natural selection.

out courage its dependence could not be maintained; without temperance its resources would be wasted; without justice between man and man it would speedily fall to pieces. And much the same might be said of honesty and veracity and benevolence and all the rest of the long list. These are all undoubtedly conditions of social health. Now it was very early pointed out that this fact might explain how it is that these virtues have spread abroad among men. The more virtuous societies have been, on the whole, the stronger both in war and in economic rivalry; they have risen and enlarged their borders, while societies less advanced in virtue have gone down to defeat. In other words, morality has what the evolutionist calls "survival value" in the struggle for existence between societies. It helps the society which possesses it to survive, while those which do not possess it, perish; and thus, if in no other manner, it spreads abroad over the earth's surface.

This account of the evolution of morality[2] is evidently incomplete in two ways. In the first place, it accounts only for the spread of morality, not for its origin and development as such; and in the second place, it accounts even for the spread of morality only as the society which possesses it spreads, and does not at all account for the spread of morality from man to man within a particular society. Each of these two problems had then to be attacked in other ways.

With regard to the first appearance of morality in the human race, we can scarcely stop to say anything here; for it is one of the most obscure problems within the domain of science. But with regard to the mode in which moral sentiments, already prevalent in a society, are found to develop in the course of time, something very definite can be said. The process seems to be very similar to that by which any useful tool or machine is gradually perfected. A well known analogy is that of the bow and arrow. This species of weapon was at first of a very simple and crude type. Any tough and elastic stick of wood of sufficient length and fair average thickness would do for the bow; and if the arrow were fairly straight and its flint point roughly sharpened, that would serve well enough. But as time went on it was found that such a bow and such an arrow would not always serve. One after another various defects came to be noticed and gave rise to more or less dissatisfaction and desire for improvement. And thus, when, perhaps, a lucky accident pointed to a better way of contriving things, the primitive inventor's mind was prepared to catch the hint and act

[2]In itself, this account marks very little advance beyond the earlier biological view. For it amounts simply to an application of the machinery of the natural-selection theory, to the explanation of the persistence of variations favorable to the survival of animals living together in groups. But in this way the origin of congenital traits alone can be explained; and no doubt certain such traits (notably the sympathetic reactions which lie at the basis of morality are to be thus accounted for. The development of sentiments, however, remains as much in the dark as ever. The real virtue of the argument may be said to have consisted in the obviousness of its defects. A resort to psychological modes of explanation now became inevitable.

upon it. By successive modifications, extending over many centuries, the bow was brought to its perfect symmetry and the arrow was balanced and feathered for its flight. Much the same thing happens in the course of moral development of mankind. Some custom or institution, which is supported by the moral sentiment of the society in which it exists, is found by repeated experiences to be seriously defective. While in general it serves a useful end, and thus confirms to that extent the judgment of past generations; still on various occasions it somehow does not work well and thus gives rise to doubt and dissatisfaction. But this very dissatisfaction contains within itself more or less obscurely the idea of its own remedy—a sense of the necessary limitations of the old law beyond which it cannot be expected to hold. Such a transformation is even now taking place in our popular notions of charity and benevolence. Most men formerly supposed, and a good many men still believe, that giving to the poor, the help of those who are in distress, is always a right act. But within comparatively recent times we have had impressed upon us as never before the lesson that indiscriminate charity may do an immense amount of harm. We have seen repeated instances of its decidedly evil effects. And thus on the one hand we have been led to question the validity of the old standard of right and wrong in this matter, and to lose something of our respect for those who continue to gratify their generous impulses with the old-fashioned thoughtlessness; and on the other hand, we are beginning to see more clearly what the proper limits of alms-giving are. When this change of sentiment has been completely effected, we shall have formulated a new moral law on the subject: "Give to the poor and needy under such and such circumstances; otherwise not." And by this moral law it may be that many generations of man shall continue to guide themselves in their acts of benevolence; until again, in the course of time, this law also comes to show its lurking imperfections, and thus to point to the further limitations which must then be placed upon it. And here, I think, we may begin to observe some justification for the remark which I made at the outset with regard to an essential agreement between Plato's view of moral progress and that to which recent investigation has led us. At least in respect to the race we may certainly say that moral education is a process of advance by means of general conceptions, which, in the very act of applying them, point to their own necessary modification—in short, a process of dialectic. Whether this holds true also of the moral education of the individual, we shall soon consider.

In order to complete our brief survey of the evolution of moral standards in societies, it will be necessary for us to make some observations with regard to the manner in which these standards are communicated from man to man within the same society; and here, at the same time, we shall be entering upon the problem of the moral education of the individual. It is here that we shall have finally to

leave behind us altogether that useful analogy of the social organism; for the process by which judgments and sentiments are conveyed from mind to mind is too peculiar to be explained by any mere illustration.

In the first place, we must note, as in recent studies of society we are so frequently asked to note, that man is an exceedingly imitative creature. I do not mean simply that he is apt to try to do what he sees other men do, but that his very opinions and tastes are strongly imitative of those which he finds prevalent in the socity of which he is a member. Huge as our self-conceit may be, we never become entirely independent of the judgments of our fellow-men. We show this constantly in trivial as well as in important matters. If our neighbor at the boarding-house table finds the butter slightly rancid he takes away our taste for it at once, though a moment ago we may have been eating it quite freely. If he approves of the dessert, that alone will raise the chances of our liking it also. The same is true of our judgments of art. We most sincerely admire many a great poem and many a famous painting which we should have set down as fantastic nonsense had not the approval of the critics recommended them to our notice. And the same again is true of our moral judgments. The decent young man, who thinks gambling and profanity and drunkenness quite wrong and never dreams of indulging in them, is apt to suffer a decided shock to his moral convictions when he wanders abroad into lands where such doings are considered a matter of course. The political reformer fresh from college finds himself within a few months a partner to acts which in former days he would have scorned to countenance, but which his new associates consider perfectly proper. On the other hand, the more our friends expect of us in the way of honesty and temperance, the more we are apt to demand of ourselves. Moral judgments, I repeat, are largely imitative; and even when they are based on reasoned conviction, they are strongly re-enforced by the similar judgments of our neighbors. Here then is one principal means by which moral standards are both maintained and extended within a society.

In the second place, a society is so constituted that the individual man has ample opportunity to verify in his own experience most of the moral judgments which he at first receives from others. He is taught that it is wrong to lie; and the lesson is doubly impressed upon him when a few of his own brood of lies come home to roost. He is taught to be frugal; and he knows well what the virtue of frugality means, when he finds himself able to maintain in comfort those who are dependent upon him. With all its infinite variety, there is a great deal of sameness in human experience; and the fundamental moral laws bear upon just those aspects of life that fall to the portion of all men alike. We have all of us need to be wise and just and brave and temperate and kind; and we can each of us veirfy in their effect upon ourselves and upon those whom we love the value of these qualities

of mind. Moral judgments are imitative, it is true; but they are seldom, if ever, merely imitative; they represent a personal experience which has corroborated the general experience. By such means, then, we may conclude, moral sentiments and ideals are maintained and extended in society.

We are now at last prepared to return to the problem, which, as students of education, concerns us most intimately—that of the development of the child. I have already given you some account of a certain theory of moral development which was quite popular a generation ago—the theory, namely, that moral sentiments are instinctive, transmitted from parent to child by physiological heredity. It should be said, however, that even in the worst period of the biological craze there were not a few men who stood apart from the general current of thought and boldly proclaimed the ridiculousness of the moral-instinct theory. They pointed out the simple, incontrovertible truth, that moral fitness is not acquired by mere heredity; that moral character has its own peculiar means of dissemination; that a virtue or a sentiment is not perpetuated simply because those who happen to possess it are thereby strengthened for the struggle for existence. Kant and Spinoza, yes, and Jesus of Nazareth have not had the less influence upon the moral ideas of mankind because they left no children behind them. In short, moral evolution is not a biological phenomenon at all; it is a matter of training, of personal influences, of education. So far so good. And yet the fact remains that it is quite as possible from this point of view as from that of the biologist to make the study of individual children of very little account for science. For suppose we look upon education as an absolutely irregular and arbitrary performance, not governed by any universal natural laws. Suppose that we are under the impression that what the child learns or does not learn depends upon mere accident, from which no generalization can be made; and that especially in the complexity of modern civilized life no uniformity can be looked for in the conditions under which different children are brought up. Then, indeed, child-study would be for us a contemptible concern; for what could be learned from one child would be of no advantage when applied to another.

The scientific solution of the difficulty—if, indeed for common sense it be a difficulty—came finally in the form of a principle which is known to us by the suggestive name of *social heredity*. The name, indeed, is apt to strike us at first hearing as being very likely nothing more than a figure of speech; but as a matter of fact it means something very definite indeed. In the lower animals the young are provided at birth with a nervous system in which a certain number of definite reactions—some simple, some more complex—are stored up; and these reactions, which we call instincts, include all the more important activities of the animal's life. But as we ascend in the scale of animal life, and the activities which the struggle for existence

calls for become more and more varied and complicated, we find, indeed, sometimes that the instincts become proportionately developed; but sometimes, too, we find that nature has as it were dropped the instinct plan as altogether too cumbersome, and, while leaving the instincts already acquired a somewhat subordinate place, puts her main reliance upon ideas and habits of action acquired by each individual after birth. With such an arrangement, however, there would be a fearfully uneconomical waste of energy, if each generation could not in some way profit by the experience of the last, but had to learn everything over again from the beginning by its own trials and errors. This waste of energy is obviated by that wonderful psycho-physical mechanism which passes under the name of *imitation.* Imitation, then, can be said to play a part in the development of the higher animals, which is analogous to the part played by the inheritance of complex instincts in the lower animals. It is this function of imitation that constitutes what we know also as social heredity.

It is obvious to us upon very slight reflection that in man the part played by social heredity is enormously greater than in any other species of animals; and in almost all human activity the part played by mere instinct seems to be very small indeed. Consider, for example, the great function of speech. This has, indeed, an instinctive basis. The baby does by mere instinct pronounce a number of scarcely artculate sounds, which serve as the beginnings of speech. But all beyond this—all, that is to say, that is peculiar to any one language or family of languages as distinguished from another—belongs to the social heritage; and all this the baby must learn from others. His ancestors may have spoken English for a thousand years; and yet he shows not the slightest observable predisposition to learn that language rather than French, or German, or Turkish, or Chinese. There seems to be no doubt that much the same thing is true of man's moral nature. This has presumably some basis in inherited tendencies of the nervous organism. A certain degree of moral talent is necessary, without which a child is incapable of developing as a moral agent; without this necessary nervous equipment to start with, he remains, so far as morality is concerned, a mere idiot. But all beyond this—all that distinguishes the ethical ideals of modern America from those of ancient Greece or Egypt; all that separates the Christian conscience from that of the most benighted heathen—all this the individual must receive from society.

In a word, the development of morality has been a social process. The individual owes his standards of right and wrong—even as he owes his standards of beauty and ugliness—to the society in which he has been nurtured. His sentiments are echoes; the judgments which he feels called upon to pronounce are imitative of the favorable or unfavorable judgments that are current in his environment; and, as we have already observed, his personal independence never reaches such

a height as to be wholly unaffected by the agreement or disagreement of his associates. This is, of course, especially true of little children. If you repeatedly express to a child a feeling of disgust which is aroused in you by any habitual act of his, he will very soon come to entertain the same feeling toward it himself; and even if the force of habit or of special temptation proves sometimes to be too strong for him, he will be apt to think badly of himself for yielding. And this is but a type of the general process by which, through praise and blame, reward and punishment, the child receives from those about him the great body of moral sentiments which are current in the society into which he has been born.

But this is by no means all that is to be said of moral development in the child. For account must be taken of another great and important factor—the reorganization of the imitated material in the course of the child's own individual experience. The moral ideal is not simply passively received; on the contrary, it undergoes in the individual a development which is closely analogous to its evolution in society. To this point we must now devote our attention.

When a child receives into his mind some judgment with regard to the rightness or wrongness of certain modes of conduct, the judgment does not lie there idly as so much mere information; it is applied and acted upon, and it is only in being thus applied that its full meaning comes gradually to light. Just as a child's first imitations of the words which he hears are crude and inexact affairs; just as his first drawings are almost unrecognizably schematic; so his earliest moral judgments are far from representing with any adequacy the opinions which he has heard expressed by others. How then does his development proceed? Well, as I was saying, the crude judgments that have been received are acted upon. So long as the consequences of such actions are satisfactory to all concerned, the underlying moral judgment need undergo no change. But occasionally it happens that the consequences are not wholly satisfactory; and in particular they are found to work injury to other persons, including those to whom the child is especially attached. Thus there is brought into operation a certain more or less powerful motive—the tendency to sympathetic feeling, which is congenitally present to some extent in all of us; and by reason of this feeling, the child finds himself dissatisfied with the course of conduct which has given pain to others. The dissatisfaction thus arising becomes then the core of a modified moral sentiment, of a new judgment which is not founded upon faith alone, but in part, at least, upon experience and insight. This is the process by which each one of us has arrived at what degree of comprehension he possesses of the meaning of the moral code which governs society. It is only by obedience to the law, as our ignorance conceives it, that we can ever attain to a better understanding of its significance.

This now, is what I meant by saying that we stand to-day in an

essential agreement with Plato's theory of moral education. For us, as for him, moral education is dialectic. It is the very persistence in an ideal that works its transformation, because it necessitates its application to unforseen conditions. The accepted standard of action—say in truth telling—when viewed abstractly, appears to be final and altogether perfect, as if it were always right to tell the truth and always wrong to tell a falsehood; but when the standard is applied in practice it reveals unexpected shortcomings—inconsistencies of such a sort, that it defeats its own end and gives rise to dissatisfaction and unrest. But this very dissatisfaction contains the idea (more or less explicit) of a modification of the old ideal by which a more adequate principle of conduct is revealed. Hence arises a dialectical development of the ideal, by differences, which are for the most part slight, but which may, at critical periods of a man's life, be momentous and profound.

Let us now for a moment consider the very different conception of the relation between individual development and race development which this theory suggests, as over against the conclusions which we drew a little while ago from the theory that morality is instinctive. We found, you remember, that so long as moral sentiments were conceived of as being passed along from one generation to another by mere physiological heredity, the manner and order of their appearance in the child had no intrinsic significance that psychological analysis might reveal; it was but a record of the order in which, through natural selection, these instincts had been acquired by the species. Thus the only significance of child-study for ethics was that in a very indirect and imperfect fashion it helped to supplement the great gaps in our knowledge of the history of human morals. Many phenomena of child-life, which have a fixed order of appearance, markedly unaffected by external circumstances, are, indeed, satisfactorily explained in just this way. But if the development of the moral sentiments is a process of a radically different sort, determined by variable factors of individual experience such as sympathy and imitation; then, without unduly stretching our terms, we may say that it is now the individual development that must be regarded as the complete process, of which social evolution is the imperfect recapitulation—imperfect, that is, because in it are obscured those all-significant facts of individual experience, by which in the last resort social evolution itself must be explained.

For the teacher and the social reformer, this general conception of the process of moral development appears to be most satisfactory. If the power of heredity were absolute, it would set a fixed limit to the possible success of all their endeavors for the moral improvement of mankind. Or if morality, like musical ability, depended largely indeed upon training, but, if anything, more largely still upon a native endowment that is anything but universal among men, the possibilities of extensive improvement would still be proportionately small. The case,

however, appears to be more fortunate. Morality, like the other great universal function of language, is, as we have said, pre-eminently a social growth. It rests upon a minimum of inherited capacity and exhibits a maximum of responsiveness to culture. Society, then, has every chance to improve itself morally, so far at least as the most general conditions of such improvement are concerned.

And yet the case is not quite so optimistic as one might first suppose. For we have still to remember that moral development, even if it be not predetermined at birth, begins its course very soon after birth, and the influences of the first few years are doubtless quite as important as common-sense has always affirmed them to be. The first seven years of life was all that the Jesuit asked for in which to fix the religious convictions of a child; and these years are not less decisive of at least the general course of moral development. To be sure, there is always the possibility of reform, just as there is always the possibility of religious conversion. But even the most radical reform and the most thorough and sincere conversion must leave untouched the greater part of the impressions of infancy.

That is one reason why I particularly like the term "social heredity." For, after all, we cannot fail to recognize that it is a species of heredity as truly natural in its way as that by which the bodily organs and functions of the species are perpetuated. It is not alone his parents' features that the child inherits, but their habits and tastes and convictions and ideals. It is commonly said that man belongs to a class of animals that are completely formed at birth, and the saying is true in a sense; but in a very important sense it is not true. For as the young marsupial must be carried for a time in his mother's pouch until his physical development is complete, so the child must remain for a more protracted season in the family until his development as a social being is complete; and the family is every whit as natural an organ as the pouch of the marsupial. Social heredity, I repeat, truly deserves its name, and during the years of infancy it pursues its course with the pitiless inevitability of a natural process.

Still, after all, the reflection remains that moral education is more even than a socially determined process. Our final word must be that it is not mere heredity, but dialectic, not mere development, but self-development. There is a power within us that shapes our ends, rough-hew them how destiny will. It is only by appealing to this power that the educator can reach the moral nature of a man or a child. This is the enduring truth of Plato's pedagogy. Virtue cannot be taught by mere imitation, because it does not pertain to a being that acts by mere imitation. "But as conduct proceeding form personal insight, from inward conviction and *knowledge,* in which alone it really consists, it is entirely teachable; for the secret of teaching it lies in arousing the power of thinking"[3]—that is to say, in directing the process of dialectic.

[3]Quoted from a privately printed essay of Professor G. H. Howison.

THE CHILD AND HEREDITY

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All education must be founded upon the nature of the child. The trainer of animals first learns all he can about the natural characteristics of the animal he is to train, but the human animal is often trained by those who never give a thought to its nature. The treatment of the child in the home from infancy to maturity, in school from the kindergarten to the end of the university course, in life from birth to full stature, can be wise and most valuable only when it is founded upon a scientific basis. We may work the greatest injury by demanding of the child the right interests and abilities at the wrong time. The tendency of education has ever been to project the conceptions and emotions of the adult down into the life of the child and to demand the reactions which should be given to those conceptions and feelings. We must look at the child from a different point of view. The old conception of child-life has wrought great injury in education and the treatment of the child both at home and in school.

Two great laws of biology must be thoroughly understood before we shall ever appreciate the child's life and point of view. The first is the old and well-established law of biology, that the embryo of every species passes through in its development all those stages of growth which its ancestors have passed through in their development from a one-celled organism. The second is a new and as yet generally unknown law of heredity, which is that the young of any animal passes progressively through all stages of heredity from the oldest and most primitive types down to the last and most recent type. These two laws apply as well to children as to the young of other animals, and when fully understood explain many features of child-life which hitherto have been inexplicable.

Child-study, which is the youngest of all the sciences, is founded squarely upon these laws and looks at the child from the standpoint of evolution. Any other point of view for the study of the child leads to the most absurd and sentimental conclusions. The first law which I have already given, may be understood from a single illustration. Its application to child-life and education is far more general than it may seem from the discussion given to it here.

Cope exhibited at the World's Fair in Chicago a few teeth from an embryonic elephant, which in themselves were interesting, but were of far greater importance to the world of science than was generally known. There had been a discussion for many years over the origin of our modern elephant. Most scientists declared that the elephant could not have descended from the mastodon because of the enamel plate

which is characteristic of the tooth of the mastodon, but is not found on the tooth of the elephant. Cope said that if the law of biology is true that the embryo of every species passes through in its development all those stages which its ancestors have passed through from a one-celled organism, then the embryonic elephant would at some time show the enamel plate on its teeth if its ancestors were mastodons. Accordingly the Asiatic elephant, which is the oldest type of elephant, was taken, and from it a half-developed embryo secured, and there on the teeth of this developing elephant was found the heavy enamel plate reaching half way up the length of the teeth. The plate forms there, but is all re-absorbed before the elephant is born. The embryo which they found was passing through the mastodon stage, and would have been born an elephant.

The same law applies to the human child. It passes through all the phases of development which its ancestors have passed through in their development from a one-celled organism to the appearance of man as such upon the face of the earth, before the child is born. I have seen two children within a week which were born with the gill openings still manifest in the neck. All children pass through that stage of evolution in which the oxidization of the blood takes place through gill openings instead of through the lungs, and frequently children may be seen which have been born without the entire removal of the first process of the oxidization of the blood. But while that great law of biology is valuable in order to give us a point of view for studying the child, placing us squarely and unwaveringly upon the theory of evolution as a basis for observing and educating the child, still the second law, which may be called the law of heredity, is far more immediate in its application to all stages of post-natal education of the child.

The old theory of heredity was that the child inherits the past, with all its various phases, *at once,* or that all the past has its influence upon the child from the moment it is born. It may easily be seen that such a view of heredity will not withstand a moment's criticism and analysis. The infant is influenced only by the hereditary influences which are of prehistoric man, and it is not until the child reaches the height of the adolescent growth, or until the child is thirteen to sixteen years of age on the average, that it begins to inherit, or be influenced by the hereditary forces of its immediate ancestry, where by "immediate" I mean the last five or ten generations.

Let us notice this law of heredity as seen in animals. We are all familiar with the fact that a white horse is born neutral gray or mouse-colored. The colt of any particular breed of horses usually does not show the characteristic red or the characteristic black or white of that particular breed until it is several months old, or until it has shed its first coat. The Jersey calf on the first day of its life does not show the characteristic fawn color, with the squirrel-gray markings, shading into

brownish black, but is a neutral shade of red. The red might deepen into the Durham red or it might pale to the Jersey red. In other words, the color of the colt and the calf are generic colors and do not take on the specific shades until the young animal has matured sufficiently to come into the field of heredity which is determined by its immediate parentage. Its color is the color of the primitive animal.

We see exactly the same thing in children. Our most beautiful men and women are frequently of Celtic blood. But those same beautiful young men and women were the most freckle-faced, red-haired, scrawny-looking children that could be found in the neighborhood. I have watched with great interest the development of a family where the mother is Irish and the father is Scotch-Irish. The children are perfectly in line with my previous description, while they mature into the most beautiful young men and women that I have ever seen. Wherever you see a racial stock which is persistent in its characteristics, as is true of the Celtic stock, you will find the child is very primitive and crude in its physical appearance and only comes into the magnificence of its ancestral characteristics in the adolescent years or as he approaches full maturity. We see the same law illustrated in the fact that most Anglo-Saxon children have light hair, which takes the family hue in adolescence.

This same law of heredity is shown well in the intellectual field. It was a great surprise to many a teacher at the close of the war to find that the freed slave child would learn just as fast as the child of the college professor or president. It is still a surprise to most educators that the Indian child, the children in the slums, and the child of the negro or any other undeveloped race will learn just as fast as the children from the best and most cultured homes, and, if put into those cultured homes side by side with the children of cultured parents, would be fully on a par with those children all the way from infancy to adolescence. It is no surprise at all to the person who knows the law of heredity by which we see that the immediate ancestry of the child does not affect it at all intellectually, providing that ancestry has been reasonably clean morally, until the child reaches the adolescent stage of development. The infant is a child of the race, and one infant will learn as fast as another, all other things being equal; but in the adolescent period the child of the cultured and trained ancestry will strip ahead and forever leave behind the child of the uncultured and uneducated race.

This is seen also in the case of insanity. Primitive people are not insane. Who ever heard of an insane savage? Who ever heard of an insane child? It is not until the child becomes an adolescent that it reaches that stage of its heredity where insane ancestors will have any influence over it whatever. Weismann set forth a most interesting theory, which some swallowed with great eagerness because it seemed to deny the law of evolution; but in his assertion that it is impossible

to inherit acquired characteristics he was childishly weak and decidedly premature in his conclusions. He had tails of mice from some three dozen generations which had been cut off from all the parents, so that the young descended from bob-tailed mice and yet the tail of the thirty-fifth generation was just as long as that of the first generation, and he therefore assumed that it was impossible to inherit an acquired characteristic. If he had been much of a scientist it might have occurred to him that the removal of a rudimentary organ would not very seriously affect the heredity. I have seen the horns removed from cows and bulls, so that within a few generations Jersey and Ayrshire calves were born, like all other calves, without horns, for that is the primitive condition evidently; but they never developed horns, which showed the influence of the immediate ancestry and proved that an acquired characteristic, even when violently acquired, may be transmitted. But Weismann's general law is absolutely short-sighted, because it never apparently occurred to him that heredity comes out in progressive and successive stages, and that the color and education and artistic ability of parents and families is not inherited by the child until the close of its full maturity. His argument, therefore, that the child of uneducated people learns just as rapidly as the child of educated people is true for the period of childhood, but it is not true for the period of adolescence, at which time the culture of the last few thousand years tells upon the developing child.

Another fact should be put with the laws which we have been discussing, and should always be remembered when reading works of evolution, and especially those of Darwin. The fact is this: There are substantive and transitive stages in evolution. There are times when the change has been sudden without any apparent connections or intervening steps, and again there have been long periods when the evolution seemed to be arrested. These transition stages are hard to catch in the development of the child or embryo, for in a few hours the embryo might pass from one stage to another, while the substantive stages are easily studied, for they remain much longer.

That great law of biology has a more extended application, for it includes infancy as well as the embryonic stage. It may be stated this way: The young of any animal passes through, in its pre-natal and post-natal development, all the stages which its ancestors have passed through in their development from a one-celled organism. The more immature the offspring at birth, the more of the development takes place after birth. In this light we must look at the human infrant, which is relatively very immature at birth, and therefore shows many of the stages through which the genus homo has passed. Interesting as the study of the human embryo is, it has little bearing on education, for the child at birth has passed through all pre-human stages—if such an expression may be allowed. Strictly speaking, the human race goes

back to the one-celled organism, and every human being begins there and is human from that moment.

The child is born with those physical characteristics and mental instincts which belong to primitive man, and if studied carefully it is hardly recognized as one of its species. Its body is unlike the adult body, and its instincts all belong to a life we know nothing about. It fears things that are not fearful, and does not fear things that are deadly. It will scream at the touch of fur perhaps, and at the sight of a mouse, but show no fear of a locomotive or automobile.

Physically, you say the child is just like its parents. Yes; but you are not a good observer if you say that. First, notice its relative parts. Its head is one-fifth of its total length, while in adult man the head is one-twelfth of the total length. The child's body is narrow from shoulder to shoulder, being only a little wider than the head, but is very deep from front to back. That relation in itself often marks the late formed man from the man of primitive times. The arm of the young infant is remarkably well developed, and its hand grasp is so great that it will support its weight with one hand longer than the best athlete. It could not stand upright if it had the strength to do so, for its legs cannot be placed in line with the spine. They hang forward at nearly right angles to the body, the lower leg falling naturally from the knee. The feet turn inwards, and the bottoms can easily be placed flat together. The young child in school often stands on the sides of the feet to rest the ankles, for the flat-to-the-floor position is not natural and must be rather painfully acquired. The foot of the babe is also prehensile. All this tells of the tree-climbing stage, and the babe at birth is relatively about as far toward full manhood as the adult was in the prehistoric stage when man lived much of the time in trees and took to them for safety, having no other means of escaping his worst enemies.

The internal organs of the child are quite as much unlike the adult's. A careful study would reveal the fact that many of the vital organs are so different in the child from what they are in the adult that they could not be used to identify the species if other parts were not seen. The heart is very small in the child and the arteries very large. The stomach is vertical, while it is horizontal in the adult. There are many other differences.

On the mental side we find the child full of instincts that are purely feral. Among them is fear of fur, big teeth, feathers, gruff voices and water. These fears appear without any experience on the part of the individual and are wholly teleological. The child in primitive times must have those fears to survive. They cause the child to shriek with alarm when it knows nothing about the meaning of the object. The child in primitive times must shriek when touched with fur, or die. The shriek became an instinct and is set on hair triggers, timed to go off at the instant of contact with the dangerous fur-bearing

animal. One child in about five today has not outgrown that fear before birth.

The fear of the darkness is interesting from this standpoint. An infant is not afraid of the dark. This fear comes on about the third year, and not till the sixth year sometimes. It is not an acquired fear, as most mothers suppose. It is purely instinctive, and hence is so hard to reason against. We cannot control an instinctive fear, but may control a fear which we have acquired, such as fear of cars and fear of being thrown from a carriage.

In primitive times the mother would always come home at night and bring nourishment and warmth and comfort to the babe in the cave or tree-top. It was the best time of day for the child. Later when others held the mother's attention the older child was weaned from the parents and driven away. Night without shelter, food or protection was a terrible thing. Darkness meant horror to the large child. Fear of darkness tells then of childhood, not infancy of primitive man.

Then comes the cruel stage. Man has had an awful struggle with other animals before he learned to use fire for protection. It was kill or be killed, eat or be eaten at sight. The child may be frightfully cruel and desire to kill Indians or tigers or other big game, and play those games on other children or animals. It is a phase of growth, and unless outgrown results in murderers or very cruel men.

At about 8 to 15 we meet in the child another substantive stage of growth. It is one of those long levels that the child does not get over easily. At this period of the child's life he resembles primitive man as we find him today in the Gypsy, Tasmanian, Bushman and some of the islanders. The boy of 10 is hardy, capable of caring for himself better than ever again in his life, sly, well knit, and morally primitive.

It is a rare thing for a child to die between the ages of 9 and 12. The death rate is lowest at that time. The child almost stops growing for a few years; some never do grow after the ninth year. The boy of 10 years has a slender leg below the knee, short thigh bone, low bridge to the nose, no beard, and in many other ways resembles the primitive savage.

In this period of his life certain tendencies appear which are as primitive socially and morally as his body is physically primitive. One characteristic is lying, and another is the tendency to take things which do not belong to him. The child is easily influenced to commit crimes, especially against property, when about ten to twelve years of age. Parents and teachers must deal wisely with this period. One could recite for hours instances of misguided parents who tried to whip out of boys and girls the tendency to steal when they needed nourishment, for they must outgrow those tendencies if ever fully cured of them. When we realize that the child is good naturally, and that tendencies to lie and steal and do evil things are evidences of poor example or

poor nutrition—same thing in either case, for both of them are forms of ill nutrition—we have gone far toward the salvation of the child and the prevention of crime.

Another tendency which crops out in these years is that of truancy. This is a racial instinct which dates back to the time when man wandered up and down the great rivers, following the migrations of fish, which he had learned to use for food. The Gypsy and other primitive tribes wander still. Dr. Kline, in his studies of truancy, finds that out of 250 runaway boys 91 per cent ran away in the spring or early summer, and 4 per cent in the fall and only 1 per cent in the winter; the others at all seasons of the year. We all know what feelings of unrest come with spring days and how easy it is to drop work and go somewhere. I knew one woman who moved in her own house every week, and her son ran away every year in April, returning only after several weeks, but was a good boy the rest of the year.

Dr. Kline has done another service in showing that runaway boys are smaller than they should be, considering their parents and nationality and all conditions. From this he concludes, and is supported by Dr. Hall, that truancy is due to lack of nutrition, which brings up the instinct that primitive man had when hungry. Not only do children wander when poorly fed, but men may revert to this habit when life conditions are not endurable. The tramp may be explained on this basis alone. The child in this stage of his growth, if poorly treated or poorly nourished, or if the old instinct impels him, will jump onto a train or run away and go to sea. A few trips and the old racial habit is awakened and he becomes a confirmed tramp.

Lack of nourishment may be due to inability to assimilate food as well as to insufficient supply. The boy who ran away in April every year was only five feet six, while his four brothers were over six feet tall, and all ate at the same table. He had some nervous degeneration which rendered his system incapable of taking in nourishment enough to cause full maturity, and, reverting in size, he reverted in habit also, to primitive man.

Truancy, like crime, is curable by good food; but whipping only increases the tendency, or brands in the old marks. All instinctive acts of this nature must be outgrown, and good nourishment is the essential factor in growth; but the mind must be stimulated as well, that moral support may be given. No amount of moral and religious training can make a moral man out of a degenerate, however, unless he can be developed into higher conditions of life.

Our prisons and asylums are full of people who are there because they were not treated properly at the age of 8 to 15 years. They are all cases of arrested development.

Nature struggles hard, but finds it difficult to bring each individual through all the lower stages up to its highest perfection. It is so much easier to make a second class than it is to make a first class man or

animal. It is the highest and last stages of growth that cost most. Many are the causes which prevent perfection of the individual, but they all result in one way or another from lack of nourishment.

This applies as well to the mental life as to the physical, and when we find arrest in growth of body we usually find arrest of growth in mind and morals as well. The spiritual nature being the highest and last to develop, many individuals are arrested before their spiritual growth has been attained. Perfect man is religious. The dwarf and degenerates are not. In good development will be seen a well-rounded spiritual as well as physical life.

The second division of a life cycle we call the adolescent period. This is in many ways the most important phase of growth. Adolescence means growth and is applied to that period in which the child grows from the long level of primitive physical and mental conditions into his more recent heredity. The infant inherits the prehistoric ancestral conditions, the boy of ten the conditions of mediæval man, or man at the time of migrations, and adolescence brings him out into the inheritance of historic or modern man. Without this last growth the child remains a primitive being. He may be sharp, able to care for himself, cruel, deceitful and cunning, but small in all the higher phases of life.

When we understand the meaning of this adolescent growth we shall see the importance of making much of it. Its characteristics are interesting and must be dwelt upon briefly.

When the child enters this adolescent stage one of the first developments is in the diameter of the heart. In infancy the diameter of the heart is to the diameter of the artery as 25 to 20; at the beginning of adolescence this ratio rises to 140 to 50, and during adolescence it rises to 290 to 61. In a word, the pressure of the blood changes fivefold or more. This alone accounts for the great impulsiveness and unbounded energy shown by the child in the teens. Next comes rapid growth in height. For the previous four years the child may not have grown more than half an inch a year, and now may grow an inch a month for as many as eighteen months in the extreme case I have observed, while an inch a month for several months is a common growth. Primitive man is short, modern man is tall.

This rapid growth in height is accompanied with changes in form and features. The nose changes shape rapidly, assuming for the first time the adult form. The brow, cheek bones, chin, forehead, color of hair, length of thigh bone, breadth of shoulders and hips, and voice change rapidly. It is called a physiological second birth.

While these changes are going on in the body there are as great mental changes. There is one general difference between the child and adolescent. The child lives in the real of the senses, the adolescent in the realm of thought. A boy spends two hours a day on the average, it is said, trying to make some new noise. While sensations are new

and frequent the child is happy, but has no resources in time of calm or the dark closet. The adolescent awakens to the meaning of life. He sometimes starts up with questions as if he had never seen the world before. Who am I? How do I know that I am I? Are these people my parents? How do I know? Who made the world? Who made God? Is there any God? Is the world real?

With his heart pumping blood through his arteries with an unwonted vigor, with new areas of his brain bursting into function, with ideals of grand heroic life, and with magnificent visions of what the future will bring him and of his own greatness, he is still treated like a kid and often tied up with red tape until he explodes from excess of unused energy.

Adolescence is a time of great and intense interests in reading, music, art, science, athletic sports; there are periods of great energy and sloth, of despondency and joy, of rebellion against home and school and all authority, of deep selfishness and as well of great generosity; emotions are strong and uncontrolled because new and unknown, and because the character has not settled. It is the time of forming the greatest ideals of life, passionate longings, the first feelings of love, and, best of all, it is the time of the blossoming of the spiritual life.

Allow me to give instances of these new stirrings in the soul.

Parents seldom realize, for they have forgotten their own adolescence, the intense desire to read which comes to the average boy and girl at 13 years of age. Franklin read poetry all night at about 13; wrote it also, and sold his poems on the street. Joseph Henry, president of the Smithsonian Institute, accidentally got into the library at Albany and read all the fiction and all the science in systematic order. Edison tried to read through the Detroit free library, and read 15 solid feet, beginning at the lower corner so as to take it systematically.

It is the golden opportunity to furnish a taste for good literature and innoculate against the worst forms of the reading habit.

Interest in music is also intense. A little girl of 15 wanted to compose one piece that would enrich all subsequent life. It is the time of the awekening of the soul to a sense of the beautiful. Seventy-five per cent of young people have a deep interest in art at about 14 to 18. They are just discovering the beautiful things in nature and life.

Said a young woman: "At 17 I meant to be a great artist. I purchased an outfit and began, but the spell soon passed away."

Another: "At 13 I longed to be a sculptor. That passed, and now —18—I want to be a musician."

It is the period when most of the great scientists got their first love for nature and research. Banks, the great botanist, was idle and worthless till at 14 he came out of the swimming hole late and walked home. He was so impressed by the beauty of the flowers on the roadside that he at once began his great career. (Score one for the boy who was behind time.) Everyone knows how the boy is interested in

sports, athletic events, horse racing, prize fights. He is not worth raising if he is not interested at 13 to 18 in such things, and not fit to live unless he outgrows most of it when he gets to be a man.

Periods of languor, inertia, laziness of both mind and body are followed by periods of abnormal energy.

F., 24: "At 16 I had such a spell of energy that I took the parlor carpet up, cleaned it, moved all the furniture, including a piano, out of the room, washed floor, put down carpet and put all back in place, and was not tired. It would have killed me ordinarily, for I am not accustomed to work. Wrote an essay in such a mood at 23, and it was criticised as not sounding original."

F., 16: "I sometimes stay in bed till noon and sit around the rest of the day. Again, I do unnecessary work in spells of great activity."

The sad side of it is that there are spells of great despondency, often culminating in suicide. This should be better known. Despondency is a natural phase of growth, and is strongest at 17, and should decline and pass away at 22 to 25. It is caused by the new body and brain functions and the general rapid change in the organism, coupled with the great fluctuations of the emotions.

It is also a time of rebellion against home and all authority. There is a deep longing in the soul for larger things, for change and for self-expression. Maturity calls for independent action. Elopements, separation from home, truancy or disobedience at school, sudden bursts of anger directed at the parent or teacher are common, and should not be assigned to a spirit of total depravity, but more likely to an unsympathetic relation of parent to child in the home, and a childish government at school.

A boy of 14 was so selfish that it was considered a family calamity. He was as generous and noble as his brothers in two years' time. A large and brilliant young woman of 17 was so cross as to destroy the home life. She said: "Mother, I know that I make life wretched here for all of you, but you don't know how cross I feel." She outgrew it at 19, and is a beautiful, sunny character at 23.

The adolescent often makes friends with older or younger persons for no other reason than to avoid sarcasm and find sympathy. The adolescent boy often falls in love with a woman 10 to 15 years older than himself, because they are more sympathetic than girls of his own age.

Religious life comes out naturally at 14 to 16 and is the last and noblest emotion of the soul. It comes about the time of love for the opposite sex, and because the highest and best should not be forced into expression when half mature any more than love should be forced by flirting. In either case we get an uncertain, namby-pamby, milk and water emotion which is luke-warm and sickening. The strongest emotions are those which are held in check till their full maturity.

To gather up the fragments of this paper, then, we must look at

the child form the standpoint of development, must understand the origin and meaning and time of development of its instincts and emotions, its longings and unrest, its feelings for home and authority, and must keep the child growing.

Nothing is so bad as arrested development. Nourishment, variety of food and plenty of it, especially such food as the child craves, must be given. As the child comes to the period of retarded growth and wandering instincts, special care must be given to its moral life and food. In the adolescent there is need of sympathy, life, inspiration and protection from moral and social crimes, for the impulses are stronger than at any other time of life, while the powers of inhibition and restraint are almost unknown. A sympathetic touch of an older and stronger friend will save many a boy and girl.

OVER-PRESSURE IN THE HIGH SCHOOL

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To assume that there is such a thing as overpressure in the High School may seem to many teachers like creating a ghost for the mere pleasure of dispelling the illusion. Nevertheless, this ghost is bound to stalk forth periodically in the minds of certain over-anxious parents or in the columns of some newspaper seeking an argument against the school administration. Even in the theorizing of some educators it is charged that the high school curriculum, with its present-day wide range of studies, and with its library and laboratory methods of teaching, is making unreasonable demands of the youth who undertakes to complete the course prescribed for graduation. Some time ago a paper was read before the Collegiate Alumnae of Detroit in which it was charged that the sessions were too long; that if the pupil did conscientious work, the course of study required from four to five hours per day at home; that to meet the college entrance requirements in the twelfth grade meant five or six subjects, with from five to six study hours each day, and that these conditions were injurious to the health and proper development of the pupil. We are all familiar with the complaints of the parents when perhaps the only child has been reported to be doing unsatisfactory work in a certain subject. Then the lessons are too long and difficult, the teacher expects too much of the pupil, and, if that parent was once a school teacher, we learn that the present tendencies in education are all wrong and that present methods can not be compared with the old of some uncertain number of years ago. We may listen patiently, and yet we know that the course of study is a growth developed out of the experience of years. We know

that the demands of a course of any value must make the student work, and we also know that we can not demand more than the average pupil will do with an average amount of effort. We should like, no doubt, to plan our work to suit the abilities of the brightest students in our classes, but the universal experience is that of a teacher who said a few days ago: "I have six pupils in my geometry class—numbering thirty-two—who are absolutely dull, and all my work is gauged to meet their demands."

It is practically impossible to make the teachers believe that there is overpressure from their standpoint. On the other hand, many parents feel that there is an excessive demand because they can not see their own children as others see them. There is, however, a third party in this discussion that, it seems to me, is the one who really knows, if he would tell it honestly, more about this question than anyone else—that is—the student himself.

To observe the actual condition and to better judge of the question of overpressure, I have attempted in a very few days allotted to me to make an investigation in the Central High School of Detroit. This school is the largest in the state, and is in many ways a representative school of high grade. As to its standing at the University, the record of its students proves more clearly than can any other argument the quality of its preparatory work. The record of the school for the past semester shows that the percentage of success was 88.51, that of total failure but 7.04 per cent, and the conditioned made the remaining 4.45 per cent. I state this for fear that some may feel the following record might indicate that satisfactory work was not being done and that our standards were low. The purpose of the investigation was to obtain an unbiased, free expression from the pupils themselves, and to secure a truthful record of work actually done for one entire week. Blanks of the following description were handed to each pupil:

Two or three days were taken for explanation before a record was begun, that it might be done correctly. It was made a voluntary matter, though all were urged to aid in securing a truthful record for the entire school. In returning the blanks filled out, the student was not obliged to sign his name, as he was assured that the purpose was not to investigate his personal record. Possibly the fact that it was so impressed upon them that only truthful and accurate reports were desired caused many not to hand them in. Full statements were obtained from 1,431 students out of a possible 2,000. While it would have been desirable to have had a more complete report, it is believed that the more reliable records were those handed in, and, therefore, we are able to draw from them the more accurate conclusions.

From these reports were obtained the time spent in recitations, in laboratory work, on subjects in which they had failed, and the time spent in the preparation of each study. The form used for illustration is an actual report of a first year student. When he handed it to his

principal, she remarked: "Why, Ralph, you forgot to copy the time spent in English!" His reply was: "You told us that this must be an honest report, and I didn't study my English this week." This report possibly represents the work of an honest boy who does as little studying as he can and at the same time keep from failure.

To judge properly of the results of this investigation would necessitate a certain familiarity with the course of study and a knowledge of some local conditions. However, a brief view of the course of study will show a few features that in part will explain some of the apparent peculiarities of the tabulated results.

9 B.	9 A.	10 B.	10 A.
English (1)..... 4	**English** (2)..... 4	**English** (3)..... 4	**English** (4)..... 4
Alegbra (1)..... 5	**Algebra** (2)..... 5		
....	....	....	....
			Alegbra (3)..... 5
		Arithmetic (1)... 5	Arithmetic (2)... 5
History (1)...... 4	History (2)...... 4	History (3)...... 4	History (4)...... 4
Latin (1)........ 5	Latin (2)........ 5	Latin (3)........ 5	Latin (4)........ 5
French (1)....... 5	French (2)...... 5	French (3)...... 5	French (4)...... 5
German (1)...... 5	German (2)...... 5	German (3)...... 5	German (4)...... 5
			Botany (2)...... 5
Geography (1)... 4	Geography (2)... 4	Botany (1)...... 5	Zoology (2)..... 5
		Zoology (1)...... 5	Physiology (1)... 5
Book-keeping (1). 5	Book-keeping (2). 5	Book-keeping (3). 5	Book-keeping (4). 5
		Phonography (1). 4	Phonography (2). 4
*Drawings (1)... 4	*Drawing (2).... 4	*Drawing (3).... 4	*Drawing (4).... 4
*Manual Training (1)... 4	*Manual Training (2)... 4	*Manual Training (3)... 4	*Manual Training (4)... 4
Physical Culture (1).... 2	Physical Culture (2).... 2		
11 B.	**11 A.**	**12 B.**	**12 A.**
English (5)..... 2	**English** (6)..... 2	**English** (7)..... 2	**English** (8)..... 2
Geometry (1)... 5	**Geometry** (2)... 5		
....	....	....	....
		Literature (1).... 4	Literature (2)... 4
			Algebra (4a).... 4
			Algebra (4)...... 2
		Geometry (3).... 3	Trigonometry (1). 4
History (5)...... 4	History (6)..... 4	History (7)...... 4	History and Civics 4
Latin (5)........ 5	Latin (6)........ 5	Latin (7)........ 5	Latin (8)........ 5
French (5)...... 5	French (6)...... 5	French (7)....... 5	French (8)...... 5
German (5)...... 5	German (6)...... 5	German (7)...... 5	German (8)...... 5
Greek (2)........ 5	Greek (3)........ 5	Greek (4)........ 5	Greek (5)....... 5
German (1a)..... 5	German (2a).... 5	German (3a)..... 5	German (4a)..... 5
French (1a)...... 5	French (2a)..... 5	French (3a)...... 5	French (4a)..... 5
Chemistry (1).... 5	Chemistry (2).... 5	Physics (1)...... 5	Physics (2)...... 5
Com. Geog....... 5	Com. Law (1)... 5	Economics (1)... 5	*Office Practice... 4
Phonography (3). 4	Phonography (4). 4	Phonography (5). 4	Phonography (6). 4
*Typewriting (1). 4	*Typewriting (2). 4	*Typewriting (3). 4	*Typewriting (4). 4
*Drawing (5).... 4	*Drawing (6).... 4	*Drawing (7).... 4	*Drawing (8).... 4
			Reviews 5

The number of hours required for graduation is 142.
The subjects printed in heavy type are required.
Before graduating ALL students must have completed:
Four years of English.

Two years of mathematics (one year of algebra and one year of geometry.)
One year of history.
One year of science.

Students electing a study running through a year must complete the year's work in that study before any credit is given, except in cases granted by principal.

The number in parenthesis, following the name of each study, indicates the number of the course in that study.

The number opposite the name of the study, at the right of the column, indicates the number of recitations per week for that study.

Drawing, Typewriting, Manual Training and Office Practice receive two hours' credit per semester. Reviews also receive one-half credit.

Physical Culture is required of first year students, but does not count as credit for graduation.

The arrangement of subjects by grades is not restrictive, but indicates the natural order to be followed in any line of work.

A study of the foot notes may be sufficient to understand the curriculum. A large proportion of the students in the second year are taking some of the biological studies, which are taught mainly by laboratory work, and this, with bookkeeping, drawing and manual training, for which no home study is required, will make the average time spent in study lower in that grade than in any other. Another peculiairty is that, in the grading of students in the last year, only those whose work is completed through the requirements of the 12-B grade are classified as 12-A's. This results in a number being graded as 12-B's who are attempting to graduate by carrying extra studies, and this will make the average 12-B work appear heavier than the rest.

The tabulated results of the student reports, with a few conclusions, follow:

TIME SPENT IN STUDY.

Grade.	Replies.	Av. Study Hrs. per School Day.	Av. Rec. Hrs. per Week.	Av. Minutes per Lesson.
12A	79	2.91	17.33	50.4
12B	102	3.21	19.11	54.2
11A	146	2.73	18.47	44.3
11B	163	2.69	18.02	44.7
10A	198	2.42	17.94	40.5
10B	190	2.47	18.18	40.8
9A	320	2.67	18.01	44.5
9B	233	2.37	17.89	39.8
Total	1431	2.65	18.11	44.8

On this chart we have the number of replies by grades, the average number of recitation hours per week, the average time spent in preparation of lessons per school day, and the average time spent per lesson. We find that while some may spend almost no time on their studies, and others from five to six hours daily, the pupil of average ability, carrying the average amount of work, is getting his lessons, at least to a passing grade, with a total of a little over 2½ hours of concentrated effort. This averages about 45 minutes to a lesson. Some lessons are learned in less time than this, and others take a little longer. This certainly is not evidence of much over-study. Please keep in mind that the average amount of work carried is about 18

hours per week of between three and four recitations per day, and the average time spent in study is about 2 hours and 39 minutes.

COMPARISON OF TIME SPENT ON CERTAIN SUBJECTS.

Subject.	9th Gr.	10th Gr.	11th Gr.	12th Gr.	Average.
English	31.4	33.1	35.2	43.0	35.6
History	49.6	41.3	43.0	55.1	47.2
Mathematics	51.2	45.0	44.05	61.3	50.4
Modern Languages	51.9	47.4	62.1	61.9	55.8
Classical Languages	40.7	52.2	44.9	72.4	52.1
Science	...	38.1	40.6	62.1	46.9

It may be of some interest to compare the amount of time spent upon certain subjects which are supposed to take up the major part of the student's time. Commercial studies and those not running through the grades are purposely omitted. This chart does not represent the actual average of the time spent by all pupils reporting in these subjects. In order to obtain a result that would show the amount of time spent by the more reliable students who were doing satisfactory work, each grade principal was asked to select from the reports a considerable number that in her judgment represented the work of the grade and whose reports might be relied upon. It is from these reports that this table is made. The least time spent is in English. History and science run about even, mathematics and the languages run very closely together for the first place in the point of time. The amount of time spent in Modern Languages in the 11th and 12th grades appears large on account of an abnormal local condition. By eliminating this feature the average is reduced to 51.8. Latin and Greek still claim the honors for the length of time in the preparation of lessons. The almost uniform increase through the grades is noticeable with the exceptions in the ninth grade, where a considerable amount of time is evidently wasted in not yet knowing how to study or ecomomize time. Some questions naturally arise as: Have all subjects an equal right to the pupil's time? Have language and mathematics the right to demand so much more than science and history?

We all seem to have the idea that "when we were young" we worked much harder than the present generation, just as the present senior in high school thinks that the ninth grade is to-day much younger and smaller than when *he* entered high school. When I was a student in the Ceneral High School, Mr. Bliss, now of the Detroit University School, made a very exhaustive investigation along this line of overwork. From his report I have been able to compare, in a way, the time spent in study and the total time spent in school and out.

TABLE OF COMPARISON.

	Hours Spent in Study.		Total Time Spent on School Work.	
	1887.	1906.	1887.	1906.
9B	3.11	2.37	6.36	5.95
9A	2.82	2.67	6.02	6.27
10B	3.08	2.47	6.26	6.10
10A	3.09	2.42	6.37	6.01
11B	2.01	2.69	5.53	6.29
11A	2.90	2.73	6.15	6.42
12B	2.82	3.21	6.07	7.03
12A	2.56	2.91	5.72	6.37
Average	2.79	2.65	6.06	6.30

The curriculum of that time was quite different from the present. There was very little laboratory or library work done. All subjects were recited every day. It was practically all text-book work which would demand more time in study than would our present methods. However, there is not a great amount of difference or as much as I was expecting to find. You will notice that in 1887 the ninth grade was studying longer than in 1906, while in the twelfth grade we are now working the longer, which is, possibly, a little better arrangement. The total averages are not so far apart after all—a matter of 8 minutes per day on study and 15 minutes on total school work.

PERCENTAGE OF OVER-STUDY.

	Over 3½ Hrs.		Over 4 Hrs.		Over 4½ Hrs.		Over 5 Hrs.	
Grade.	No.	Percent.	No.	Percent.	No.	Percent.	No.	Percent.
12A	23	29.11	10	1.27	4	.51	2	.25
12B	45	44.11	19	1.86	10	.98	7	.68
11A	40	27.39	24	1.64	3	.21	0	.00
11B	38	23.31	19	1.16	6	.36	4	.25
10A	22	11.11	8	4.04	5	.25	3	.15
10B	30	15.90	9	4.74	6	.32	1	.05
9A	60	18.75	27	8.44	17	.53	13	.41
9B	21	09.01	12	5.15	8	.34	6	.26
Total	279	19.49	128	8.94	59	.40	36	.25

Is there over-study in the high school? There are always a few plodding, conscientious pupils who are naturally so constituted that they can not help over-working. Some may not know how to use their time to advantage, but with all possible explanations there are very few who are studying more than is good for them. Those studying more than the average of 2.65 hours per day, I have grouped as follows: over 3½ hours, over 4; over 4½, and over 5 hours per day. Only 19 per cent are spending over 3½ hours. Not quite 9 per cent over 4 hours, and only .4 of 1 per cent over 4½. The .25 of 1 per cent studying over 5 hours per day does not indicate that very many students are suffering from the excessive demands of the school. Practically all of these individual cases when inquired into are explained by an attempt to carry too much work to make up for lost time, or by a lack of knowing how to use time in study.

To obtain more completely the student's point of view, questions were asked of the eleventh and twelfth grade pupils as follows:

1. Are you regularly employed in the afternoon or evening? If so, how many hours are thus spent each day?

2. Are you studying music or any other subject regularly outside of school? If so, how much time is actually required each day?

3. Do you consider the course of study as planned for graduation burdensome to the pupil who does his work faithfully?

STUDENTS APPROVING COURSE.

Grade.	No.	Percent.	Number Working.	Av. Hrs.
12A	74	93.7	23	3.5
12B	93	91.1	29	2.0
11A	121	82.8	30	2.4
11B	131	80.4	39	2.0
Total	419	85.5	121 or	28.8%

You will observe that the students longest in school approve more fully than those who still have a year ahead of them. Of the eleventh and twelfth grades 85.5 per cent approve the course of study. Of these there are 121 or 28.8 per cent who are regularly taking outside lessons or working an average of over two hours each day who do not feel that the work is burdensome. The individual answers to the last question are rather interesting. Many expressed their emphatic views by printing NO in large letters, underlined, or with several exclamation points after it. Such expressions as "Not a bit," "Decidedly No," "Not for me," "Of course not," were frequent. In talking with many individual students I have found that the general idea prevails that very little hard studying is done.

STUDENTS THINKING COURSE BURDENSOME.

	Weak.			Over-Ambitious.				Slow.			Lazy.		
Grade.	No.	Rec.	St'y.	No.	Rec.	Wrk.	St'y.	No.	Rec.	St'y.	No.	Rec.	St'y.
12A	..	...	..	..	...	..	..	5	16.8	3.3	..	...	..
12B	6	21.2	3.4	1	18.0	3.0	3.2	1	19.0	3.9	1	17.0	1.7
11A	11	20.5	2.9	4	20.0	2.0	2.9	6	16.5	3.9	4	16.0	1.5
11B	7	21.1	3.3	9	17.0	2.4	2.6	10	16.1	3.3	6	16.6	1.8
Total	24	21.3	3.2	14	18.3	2.5	2.9	22	17.1	3.6	11	16.5	1.6

Fourteen and one-half per cent replied that they did feel that the requirements were too heavy. These naturally fall into four classes as follows: (1) The weak, or those who have failed and are attempting to carry one or two extra studies to make up for lost time as shown by the table: (2) The over-ambitious or those who attempt to carry full work in school or 18.3 hours of recitation, and at the same time take up music or some outside study, or regular employment for an average of two and one-half hours each day and then study for about

three hours: (3) The slow or plodding student who must study much longer than the average student while carrying less work; and (4) The lazy student who carries as few subjects as the law allows and who studies as little as possible on them, as the table shows spending a little over 1½ hours per day in study. It is not difficult to understand why each of these students answered the question in the affirmative. When interviewed personally no student could justify himself on second thought, for having handed in this answer. We may therefore conclude that the students do not think themselves greatly abused.

The high school life is becoming a very prominent factor in the education of the high school pupil. If we look into the individual cases of over-work, we find that very often the burden comes from the many organizations or social influences about the school rather than from the course of study. From the fact that he is enrolled in the school, the pupil is confronted with a great variety of influences which bear upon him with a pressure that proves disastrous to some and to those who survive a most valuable school of experience.

Upon entering the school the poor ninth grader is met with beautifully decorated portions of the blackboard inviting him to join or attend as the case may be some of the following attractions: Athletics according to season—football, basketball, hockey, baseball and track. Even though he may not take active part in these sports, if he catches the high school spirit, learns the yell, and wears the proper insignia on his cap, he feels in duty bound to witness the afternoon practice and attend all the games. If musically inclined here is his opportunity. The Orchestra, Boys' Glee Club, Girls' Glee Club, Choral Society, Boys' Mandolin Club, and Girls' Mandolin Club, are all seeking new members. Possibly he may be enticed more by the announcement of a Dramatic Club, Debating Society, or the solicitations to contribute to the monthly paper or annual of the school. If he is of a certain type, not difficult to describe, he is soon made acquainted with the fact that there are several high school fraternities that would like a considerable portion of his time. This poor ,bewildered youth may possibly have had some associations with his church, Sunday school or neighborhood that demanded a little of his time before entering high school, but now! What will he do with it all? The natural impulse is to take it all in if possible and perchance to do some studying on the side. For the first time in his life he is master of much of his own time. He is now expected to do most of his studying at home. How to use time to advantage he has never learned. Few attempt to solve the problem but rather follow impulse and become involved in the whirlpool of too many temptations. Let the teacher go down-town on a pleasant afternoon and many familiar faces will greet him with a conscious smile, or if he attend the theater or social gathering during the week he receives many a request not to call on somebody in recitation the next day. Here is the usual cause of over-pressure! The

schools can do much and some of them are doing a great deal, through faculty supervision of all departments of school life, to guide the pupil through this maze of attractions, and to give him the benefits to be found in the various organizations without allowing them to interfere with his studies. The many temptations outside of the school that interfere with the student's work are beyond our control and their solution lies wholly with the parent. Do not think that I am objecting to the existence of all these evidences of student activity; on the contrary I am very much in favor of them all when under the proper faculty control. If it is the duty of the high school to prepare the student for actual life, he should not be sheltered too long from the many demands that life and society are making upon us all. He should realize that he must choose wisely, distinguish between duty and pleasure, and judge well of the best use of his time. If the student can learn by his high school experience how much of his time he can allow from business to society, athletics or other attractions without a sacrifice of success in all lines, he will have learned a most valuable lesson.

The result of this investigation is sufficiently accurate and complete to show that the average student is not spending the time upon his studies that perhaps we or his parents thought he was. Very few have been found who are at their work longer than is good for their health or proper development. By comparing the time spent on various subjects we can not help wondering whether the students are spending the greater portions of their time in the subjects which will give the greater return for the actual time spent. We are convinced of the fact that boys and girls are much the same today as they were a generation ago, and that they are dividing their time just about as they always have done. The average student does not feel himself burdened with work, and he is fully enjoying the various social or athletic opportunities without allowing them to interfere seriously with his scholarly standing. Overpressure, then, as charged, does not exist in the high school. It will appear to most teachers that more could be demanded of the average student to his advantage because the life and demands of the school should require an exerting of will power and a putting forth of effort upon his part if he is to be prepared to do battle with the world. His experience before graduation should give him some idea of the pressure that he must inevitably face and under which he must eventually stand or fall.

CONFERENCES

CLASSICAL CONFERENCE

IS LATIN HOLDING ITS OWN IN OUR HIGH SCHOOLS?

PRINCIPAL GEORGE R. SWAIN, BAY CITY EASTERN HIGH SCHOOL.

Something over a year ago I found that in the Bay City Eastern High School the enrollment in Latin classes, especially in Cicero and Vilgil, had for some time been diminishing. After speaking of the matter to several other persons interested in school work, I began to suspect that the condition was not local, but probably true of the state as a whole and perhaps true of neighboring states as well. Happening "sive casu sive consilio deorum immortalium" to mention the matter to Professor Kelsey, the chairman of the Classical Conference a year ago, I was straightway requested to look the matter up and report this year.

Knowing that a conclusion based on surmise, conjecture and inference would justly be relegated to the limbo of Cassandra's prophesies, I have fortified my position (which will be formally stated later on) with defenses of statistics, which, though markedly defective, will yet give a fair basis for reasonably accurate generalizations.

The inquiry, at first limited to our own state, was afterward broadened to include the group of north central states—Minnesota, Wisconsin, Iowa, Illinois, Indiana and Ohio. Return postal cards were sent to the leading schools with a blank on the return card asking for statistics giving total enrollment, total number studying Latin, number of graduates, and number of graduates having four years Latin for each of the five school years just passed.

Much difficulty has been encountered in getting the desired data, for in many cases high school records have through accident been destroyed, are sadly incomplete, or are in such form that answers to my questions could be obtained only by arduous research in dusty pigeonholes. In consequence, to many cards I received no answer, and in numerous other cases only incomplete replies. My hearty thanks are hereby given to the people who did take the trouble to send complete statistics. The following tables show the results of my investigation:

TABLE I—MINNESOTA.

Cards sent, 45; complete replies, 17; incomplete replies, 9; total, 26.

Complete replies from the following schools: Albert Lea, Alexandria, Anoka, Cloquet, Detroit, Duluth Central, Faribault, Fergus Falls, Glencoe, Hastings, Little Falls, New Ulm, Owatonna, Red Wing, Rochester, St. Paul Central, Stillwater, Winona.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs.
1900-1901	3800	1733	45.6	431	208	48.2
1901-1902	3986	1924	48.2	543	245	45.1
1902-1903	4254	2063	48.4	599	254	42.4
1903-1904	4651	2182	46.9	608	245	40.3
1904-1905	4991	2288	45.8	625	237	37.9

This indicates that the number taking Latin is practically the same per cent as five years ago, but shows a steady decline in the per cent taking four years of Latin.

TABLE II—WISCONSIN.

Cards sent, 45; complete replies, 12; incomplete replies, 8; total, 20.

Complete replies from the following: Beaver Dam, Green Bay, Janesville, La Crosse, Menominee, Milwaukee South Division, Milwaukee West Division, Ripon, Sheboygan, Washburn, Waukesha, Waupun.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs.
1900-1901	3003	1161	38.6	313	134	42.8
1901-1902	3044	1101	36.1	356	150	42.1
1902-1903	3288	1024	31.1	361	149	41.2
1903-1904	3200	960	30.3	412	141	34.2
1904-1905	3401	927	27.2	420	115	27.3

*Paper and discussions at the classical conference, March 29.

This shows a decline in the number taking Latin of over 11 per cent, and a decline in the number taking four years Latin from 42.8 per cent to 27.3.

These statistics from Minnesota and Wisconsin may, I think, be considered representative, including as they do both large and small schools.

TABLE III—IOWA.

Cards sent, 46; complete replies, 9; incomplete replies, 9; total, 18.

Complete replies from the following: Boone, Clinton, Dubuque, Hampton, Knoxville, Lyons, Maquoketa, Missouri Valley, Newton.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1900-1901	1623	994	61.2	230	110	47.9
1901-1902	1731	1053	60.8	217	110	50.6
1902-1903	1834	1083	59.0	245	129	52.6
1903-1904	1877	1115	59.4	216	117	54.1
1904-1905	2013	1121	55.6	208	109	52.4

This shows a falling off in the per cent taking Latin, while the number taking four years Latin has on the whole increased.

TABLE IV—ILLINOIS.

Cards sent, 50; complete replies, 6; incomplete replies, 10; total, 16.

Complete replies from the following: Decatur, Elgin, Evanston, Freeport, Kewanee, Streator Township.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1900-1901	2517	1102	43.7	320	110	34.3
1901-1902	2406	1105	45.9	291	85	29.2
1902-1903	2357	1108	47.0	304	86	28.2
1903-1904	2432	1093	44.9	256	88	34.3
1904-1905	2565	1178	45.9	315	98	31.1

I do not consider the statistics from Iowa and Illinois extensive enough to make any conclusion based upon them very reliable. I have been unable to secure any figures from the Chicago high schools. Principal Boyer, of the Bloomington high school, writes that the number taking Latin is decreasing each year.

TABLE V—INDIANA.

Cards sent, 50; complete replies, 10; incomplete replies, 3; total, 13.

Complete replies from the following: Columbus, Hammond, Indianapolis (Shortridge), Michigan City, Mount Vernon, Rockport, Tipton, Valparaiso, Washington, Winchester.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1900-1901	2573	1879	73.0	264	117	44.3
1901-1902	2549	1852	72.6	313	94	40.0
1902-1903	2686	1964	73.1	277	70	28.5
1903-1904	2740	1975	72.0	335	109	32.5
1904-1905	3088	1978	64.0	303	107	35.3

Here although the number of graduates having four years' Latin has increased for three years, still the last year shows a marked decrease in the total per cent taking Latin; this augurs ill for the future. Miss Campbell, teacher of Latin at South Bend, says the number taking Latin is decreasing in that school.

TABLE VI—OHIO.

Cards sent, 60; complete replies, 15; incomplete replies, 7; total, 22.

Complete replies from the following: Ashtabula, Canton, Cincinnati (Woodward), Cleveland East, Columbus North, East Liverpool, Elyria, Findlay, Ironton, Newark, Sandusky, Springfield, Steubenville, Tiffin, Xenia.

Year.	Enrollment.	Latin.	% Latin.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1900-1901	5706	3309	57.9	654	433	66.2
1901-1902	5884	3457	58.7	637	401	62.8
1902-1903	6183	3575	57.8	695	385	55.3
1903-1904	6317	3595	56.9	643	376	58.4
1904-1905	6854	4287	62.5	754	434	57.5

These statistics are probably representative enough that fuller reports would not change the per cents materially. It is to be noted that the per cent of pupils studying Latin is greater in 1904-1905 than in any previous year.

So much for our neighbors. In our own state I attempted to trace the vicissitudes of Latin for ten years instead of five. In place of reply postal cards, letters with a blank and return addressed stamped envelope were sent. As was to be expected, the difficulty in securing

data was more than doubled in trying to cover ten years instead of five. The results are given in the following table. In this table, after the column giving the per cent studying Latin is inserted a column giving the corresponding per cent for all the high schools of the United States according to the latest report of the Commissioner of Education, Dr. Harris:

TABLE VII—MICHIGAN.

Letters sent, 51; complete replies, 15; complete for last five years, 19; incomplete, 10; total, 29.

Complete replies from Ann Arbor, Battle Creek, Bay City E. S., Detroit Central, Detroit Eastern, Flint, Iron Mountain, Kalamazoo, Marshall, Monroe, Muskegon, Port Huron, Saginaw E. S., Saginaw W. S., St. Joseph.

Complete replies for last five years: Charlotte, Jackson W. S., Manistee, Ypsilanti.

Year.	Enrollment.	Latin.	% Latin.	% in U. S.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1895-1896	5648	2679	47.4	46.2	546	205	37.5
1896-1897	5927	2895	48.8	48.4	564	187	33.1
1897-1898	6455	3144	48.7	49.7	612	280	45.7
1898-1899	6489	2906	44.7	50.4	673	226	33.5
1899-1900	6597	2894	43.8	50.6	616	237	38.4
1900-1901	7407	3206	43.2	50.6	791	358	45.2
1901-1902	7639	3080	40.3	50.1	795	289	36.3
1902-1903	7699	2990	38.8	50.3	831	286	34.4
1903-1904	7898	2989	37.8	...	899	237	26.2
1904-1905	8899	3326	37.2	...	908	241	26.5

The apparently heavy increase in enrollment for the year 1900-1901 is in part due to the introduction at that point of the statistics from Charlotte, Jackson W. S., Manistee, and Ypsilanti.

Of all the schools mentioned above, Flint, Iron Mountain, Monroe, Port Huron, Manistee and Jackson W. S., only show an increase in the number of pupils taking Latin during the last two or three years; the falling off in the other schools has more than balanced the gain here. It is noticeable, however, that the decrease for all the schools is less the last year than for some years preceding, while there is a slight gain in the per cent of graduates having four years Latin.

The table shows that for the schools under consideration the per cent of pupils taking Latin has fallen from 48.8 in 1896-1897, to 37.2 in 1904-1905, and that the per cent of graduates having four years Latin has fallen from 45.7 in 1897-1898, to 26.5 in 1904-1905.

The following table shows the results obtained by combining the statistics for the seven states investigated:

TABLE VIII.

Minnesota, Wisconsin, Iowa, Illinois, Indiana, Ohio and Michigan.

Year.	Enrollment.	Latin.	% Latin.	% in U. S.	Graduates.	4 Yrs. Latin.	% 4 Yrs. Latin.
1900-1901	26629	13384	50.2	50.6	3003	1470	48.9
1901-1902	27239	13572	49.7	50.1	3152	1374	43.5
1902-1903	28301	13807	48.7	50.3	3312	1368	41.3
1903-1904	29115	13909	47.7	...	3369	1313	38.9
1904-1905	31808	15105	47.4	...	3533	1341	37.9

This shows a much greater decrease proportionally in the number of pupils having four years' Latin than in the total number taking Latin.

The next table is inserted for the purpose of showing at a glance the per cent of pupils taking Latin in the schools investigated in the seven states already mentioned:

TABLE IX.

Percentages of Pupils Taking Latin.

Year.	Minn.	Wis.	Iowa.	Ill.	Ind.	Ohio.	Mich.	Ave.	% in U. S.
1900-1901	45.6	38.6	61.2	43.7	73.0	57.9	43.2	50.2	50.6
1901-1902	48.2	36.1	60.8	45.9	72.6	58.7	40.3	49.7	50.1
1902-1903	48.4	31.1	59.0	47.0	73.1	57.8	38.8	48.7	50.3
1903-1904	46.9	30.0	59.4	44.9	72.0	56.9	37.8	47.7	...
1904-1905	45.8	27.2	55.6	45.9	64.0	62.5	37.2	47.4	...

This shows an increase in the per cent taking Latin in Ohio, but a decrease in all the others, the loss apparently being greatest in Wisconsin.

Lastly, the following table exhibits a comparison of the percentage of graduates having four years' Latin in all the schools reporting full statistics:

TABLE X.

Percent. of Graduates with Four Years Latin.

Year.	Minn.	Wis.	Iowa.	Ill.	Ind.	Ohio.	Mich.	Average.
1900-1901	48.2	42.8	47.9	34.3	44.3	66.2	45.2	48.9
1901-1902	45.1	42.1	50.6	29.2	30.0	62.9	36.3	43.5
1902-1903	42.4	41.2	52.6	28.2	28.5	55.3	34.4	41.3
1903-1904	40.3	34.2	54.1	34.3	32.5	58.4	26.2	38.9
1904-1905	37.9	27.3	52.4	31.1	35.3	57.5	26.5	37.9

This shows that there has been a heavier decrease in the per cent of graduates having four years' Latin in Michigan than in any other state.

In view of the statistics tabulated, I consider that the following propositions are rendered highly probable:

1st. There has been a slight falling off in the per cent of pupils taking Latin in these seven states.

2nd. The decrease in Michigan has been about twice the average decrease.

3rd. During the same period (the preceding five years) there has been a marked falling off in the per cent of pupils graduating with four years Latin.

4th. In this falling off, the decrease in Michigan has been markedly greater than in any other state of the group.

So far as the decrease in the total number taking Latin is concerned, two things have perhaps had something to do with it, although there are doubtless others factors. First, in some of the larger schools at least the increase in enrollment has been in part due to the better facilities offered in obtaining a business education, and this has at-

tracted some pupils who otherwise would not have entered high school at all. Second, with the large increase in enrollment, we are getting more and more pupils (I suspect) from families of little academic culture where parents see little good in any form of education that does not straightway facilitate the speedy capture of the almighty dollar.

With reference to the smaller number taking four years Latin, the situation is somewhat puzzling. Three things at least have contributed to the present unsatisfactory state of affairs: First, Latin is no longer required by the University of Michigan for the degree most desired by many prospective college students; second, the wider range of electives now offered in the larger high schools; third, a disinclination on the part of many, or of some at least, of the present class of students in high schools for earnest, steady, sustained hard work in any direction, let alone four years of it. In my opinion this last is to be in part explained by the amount of social frivolity indulged in by would-be society young men and ladies, who, had they wiser parents, would be simply high school girls and boys.

In any case, the state of affairs is one that should no longer be ignored by friends of Latin, in school or out.

In conclusion, with respect to Michigan, as some indication that conditions may improve, come the words of Principals Nye, of Traverse City, and Marsh, of Jackson W. S., who report a marked increase in Latin enrollment, and the cheerful message of Principal Wade, of Flint, who declares that he fully expects to graduate a class in 1908, one-half of whom will have had four years' Latin.

DISCUSSION OF PRINCIPAL SWAIN'S PAPER.

BY PRINCIPAL DAVID MACKENZIE, DETROIT CENTRAL HIGH SCHOOL

I.

Though acceding to Professor Kelsey's request that I discuss this paper, I do not feel that I have much of value to give, either in the way of diagnosis or prescription; for I must speak not as a teacher of Latin, and, therefore, not with the authority of a close observer and a specialist, but from the administrative standpoint, which, however, may afford a clearer judgment because it is more distant and less disturbed.

The last decade undoubtedly shows a marked decrease in the number of pupils studying Latin in high schools both in Michigan and throughout the United States; still I do not regard this in the light of senile decay, but rather as a readjustment and natural change characteristic of all healthful maturity compared with the rapid and irregular growth of youth. There is then nothing alarming or appalling in the statistics of the paper. The decrease is in part the result of radical

changes in industrial and social conditions—and these always have been and always will be the determining factors in educational ideals—and in part the result of unwise and unpedagogical methods of instruction.

The first general fact that I would present for your consideration is the remarkable growth of high schools during the present generation, and some of the effects that have resulted from this growth in our efforts to adjust the curriculum to the needs of the pupils. In 1860 there were but 40 public high schools in the United States. In 1880 this number had increased to 800, and in 1900 to over 6,000. At the present time the enrollment compared with the population is greater than it is in any other country, exceeding even that of Prussia by one-half of one per cent. The high school therefore, has been passing through a great formative epoch, which has shown many fluctuations and will continue to show such, probably, before it attains to a natural and steady growth.

The high school now is a distinct unit in the educational organism. It is neither a mere extension of the elementary school, nor a preparatory annex of the college. Although occupying an intermediate place in the educational triad between the elementary school and the college, it has a distinct aim and purpose of its own, and must have freedom and opportunity to grow and to develop in accordance with the new demands of the times. In recent years it has shown two prominent phases in its development, each of which leads as easily and directly to social and industrial efficiency as did the older academic system of instruction. I do not intend to enter here upon a defense of manual training and commercial studies, but wish merely to state what is evident to all unbiased secondary teachers—that these two departments of progressive high schools offer to a large proportion of pupils a more attractive and a more rational mode of instruction and training than does the purely academic program. The introduction and rapid extension of these subjects into even the smaller high schools and the phenomenal growth of their counterparts in the schools of technology and of commerce in all of the larger colleges and universities has of itself been an all-important factor in determining the rapid decrease in the number of pupils who study Latin in our secondary schools. And this, it seems to me, should suggest the real question that should occupy our attention. It is not how shall we increase the number of pupils in Latin, for this is comparatively easy since it rests almost entirely with ourselves, so great is our influence over pupils in this respect; but rather—and this is much more difficult—how are we to determine who among our pupils will be most benefited and helped by the study of Latin?

But there is another factor in the growth of the high school that has helped to decrease the number of Latin pupils, to which I would call your attention. For many years the proportion of girls in the high school was increasing over that of the boys. But the great indus-

trial development of the present decade and the corresponding enlargement and adjustment of the curriculum has brought about a great change in this respect. In the Detroit Central High School in 1900 the percentage of boys in the graduating class was only 31. In 1905 this had increased to 61, and in our present class the percentage of boys almost equals that of the girls. Now this has been an important factor in causing a proportionate decrease in the number of Latin pupils. For when the number of girls was so much greater than that of the boys, the proportion of pupils studying Latin was greater, because a larger number of girls than boys elect Latin, since girls are naturally more conservative than are boys, are much more inclined to follow tradition and custom, and especially are more willing to accept without question the judgment and wishes of parents and teachers.

The second general fact that I would raise for consideration as affecting the number of pupils now studying Latin is the influence of collegiate affiliation and control. This relationship has, I think we must all admit, been helpful to the high school. It has proved a powerful stimulus in raising standards of scholarship in all schools, in strengthening and developing the weaker schools, and in establishing new ones everywhere. Yet the high school has now become quite a lusty youth, and may be advantageously permitted to work out its own development, uncontrolled, directly or indirectly, by collegiate standards and requirements. The removal of Latin from the entrance requirements of most colleges, which is to be commended as a recognition of the right of the school and the student to this larger freedom has, of course, lessened the number of college preparatory students who are taking Latin. But by what pedagogical right does a college impose such conditions indiscriminately on all who wish to enter its halls? The same results would appear also in the case of mathematics and physics, were the irrational restrictions in these subjects removed.

I do not agree with the speaker in his declaration that the chief cause of the decline is, perhaps, because pupils no longer are willing to study with the same intensity as formerly and, therefore, finding Latin too difficult, choose easier subjects. My conviction is that pupils not only study as much as they formerly did, but with much more intelligence and with better results. In my day the college preparatory curriculum included scarcely anything but Greek, Latin and mathematics, in which there were daily recitations. I am confident, nevertheless, that the work done in mathematics in the Central High School by the present generation is superior in quantity and quality to that done by my generation, while the work that is done today in history, English, and science is entirely new and was not even attempted twenty years ago. Notwithstanding all this increase in other studies, I fail to see any inferiority in the classical work of today. Finally, from an investigation that has been made in our school within the past few weeks, we learn that the average time spent by pupils today compares favor-

ably with that of the pupils of fifteen years ago, when a similar investigation was made. I do believe, however, that the fact that the classical preparatory requirements are heavier than they should be and are greater than those in English, history, and some of the sciences turns many from the pursuit of Latin and Greek. The average pupil today has a keen appreciation of values considered from his viewpoint, and he does not fail to observe, when he makes out his program of studies, that for two units of credit he must give 20 hours of recitation in Latin, 25 in Greek, and only 16 in other subjects. Another baneful effect of college domination over the study of Latin in the high schools is to be found in that unpedagogical principle which was given expression in the "Report of the Committee of Ten," viz., that "fitting for college and for life are the same." This theory does not permit us to recognize the fundamental differences that exist in the mentality of pupils and in their aims, and practically forces us to teach Latin to all pupils in accordance with the methods and the requirements prescribed by the colleges. The majority of the pupils in our high schools have no intention of ever going to college even although they do study Latin; and they should have the opportunity of getting from this study whatever values it may possess for them. To secure such results requires that the subject should be approached in many different ways. Surely no practical teacher will insist that the same method should be followed whether a pupil is to study Latin one year, two years, or four years, or even for additional years in college. I hold that for some pupils there may be great value even in one year of Latin; but a pupil is apt to question the truth of this and will certainly hesitate to undertake it, when he learns that the college authorities deny that it has any value, as they certainly imply when they refuse to give any credit for less than two years' work. I find upon questioning pupils as to the reason of their choosing Latin that many of them have been persuaded to do so by parents and elementary school teachers who have had but one year of Latin, but have found that that one year has been of great value to them.

It is my belief that the generally prescribed method of teaching Latin to high school pupils is unpedagogical and, therefore, is unsatisfying to them. The child's mind is not logical, critical, and intensive, which is the assumption of the method in general use, but it is perceptive, concrete, and above all creative. Undoubtedly the rudimental work of first year Latin with a wide-awake and sympathetic teacher is valuable in many ways, but it necessarily grows uninteresting and irksome, especially when it is overweighted with innumerable disconnected and almost meaningless sentences in prose composition, because it confines him to parts instead of larger wholes, deprives him of all initiative, and is devoid of any content that illumes his vision and interprets for him his life.

Another important defect in our method is to be found in the

almost complete subordination of literature to language. This, how-practice is to impose on our pupils the critical and intensive reading of a few masterpieces instead of encouraging a wide reading for the cultivation of taste and literary appreciation. To return to our Latin, we read Cæsar and Cicero, Ovid and Virgil largely for the opportunity they afford—at least so it must seem to the pupil—of illustrating syntactical principles. And yet Cæsar was a world conqueror, Cicero a great orator, jurist, and statesman, Ovid and Virgil most delightful poets and interpreters of the life and thought that Rome and the Roman people embodied. That Latin is regarded by pupils as only a "grind" and as contributing so little to the enrichment of their mental and spiritual life is the fault of our method and of the insignificant results that the teacher himself too often has derived from his Latin reading and study in college. He can not give what he himself has not gained, and so continues to teach others as he himself was taught. He must through his advanced collegiate studies have so entered into the spirit of Latin life and thought that he can re-create in his classroom the old Roman life and atmosphere and, banishing all mechanical habits, vivify his work and reveal to his pupils the message which Rome still has for the world.

In conclusion. If Latin is declining in popularity among our pupils, the remedy lies largely in ourselves, as teachers and school officers. Pupils are ever ready to accept the opinion of a teacher whom they respect in the matter of the selection of their studies. Personally I have found it an easy matter to influence any proportion of a class to include Latin among their optional studies. As principal I have made it a practice each term to talk to the entering classes upon the value of different studies, and have been forced to speak with the greatest care in order to prevent what seems to me is too large a proportion of the pupils from electing Latin. If this be the case—and I do not believe my experience in this respect is peculiar—surely when they do not continue the subject after beginning it, it must be because they do not feel that they are getting value received. The fact that so many pupils at the present time discontinue their Latin after completing two years of it is, of course, because so many of our boys are preparing for the technical courses in college, and must meet the varied requirements of these schools. But I am sure the commonly prescribed work of the second year is responsible for much of this. After a boy has labored with all the difficulties and the uninteresting content of Cæsar, his brief and hurried introduction to the new and in some respects greater difficulties of Cicero very naturally convinces him that he has no desire for a further acquaintance with Latin literature.

If, then, we really believe that Latin is of value to all who desire a wide outlook upon life and direct participation in the heritage of the past, and desire that as many as possible of our pupils should have this opportunity, let us, first of all, eliminate the more obvious errors

in our methods and courses of study, and let us also remember that although Latin has been for long the great highway upon which students have traveled, yet today it is not the only road, and for many is not the most direct road, to a life of the widest usefulness.

II.

BY PROFESSOR BENJAMIN L. D'OOGE, MICHIGAN STATE NORMAL COLLEGE

I think we should be grateful to Mr. Swain for having gone to the trouble and expense of gathering these statistics. At the same time there is cause for regret that his labor has been so largely in vain, owing to the failure in getting replies to his letters. This, while due to no fault of his own, must of necessity detract from the value of his inferences. In fact, the number of complete replies received from any one state is so small that it is impossible to generalize from them or come to any reliable conclusion. Still my own observation and inquiries lead me to the conviction that the conclusions are in the main correct in so far as they show a decrease in the number of those studying Latin and Greek, and I am further convinced that in Michigan the conditions are much worse than his statistics show. A leading publisher, who makes a business of keeping posted on such matters, told me recently that Michigan, formerly the leading state in classics in the Middle West, has now fallen below the average, and in a list of twenty-five states of the Middle West and South would stand about the fifteenth in rank. I do not think this is exaggerated.

This discussion ought to bear practical fruit in making teachers of the classics in Michigan fully alive to the grave peril in which they stand and lead to an aggressive awakening. The remedy for these conditions lies largely in their hands. In my judgment three lines of action are open and should be followed: First, personal work with students, in directing their election of studies; second, better preparation of teachers and more effective teaching; third, better facilities for teaching in the way of books, maps, and illustrative material. In these ways better results can be shown and greater interest in the classics aroused.

It must be frankly stated that the evil times in Michigan are due primarily to the change in the university requirements for admission, and I do not believe we can hope for a change for the better as long as the requirements remain as they are. It seems to me that the time is ripe for reopening the whole question of college requirements in this state. The secondary school people were satisfied with the old requirements. The attack upon them came not from them but from forces in the university. If the university will lead the way back to the old requirements, the secondary school will gladly follow.

III.

BY PRINCIPAL F. L. BLISS, DETROIT UNIVERSITY SCHOOL

I am placed at a disadvantage in attempting to discuss a paper which I have not heard, but the very careful syllabus of the paper given me in advance will serve as a good guide.

I will make an attempt to answer in particular the question as to why facts are as they are. It is perfectly clear from the statistics presented this morning that there has been, in a large number of schools in the North Central States, a falling off in the number of students pursuing Latin, and, especially, a much larger falling off proportionately in the number of students pursuing the four years' course in Latin.

This fact must have some cause. It seems to me that the explanation is a very simple one. It may be well to state in advance that to my mind it is clear that the colleges are solely responsible for this state of affairs.

The thing that I regret this afternoon is that we have not with us all trustees and the faculties of the colleges in every state, from which statistics have been given. I think some of them would be converted, and would realize that it is possible for the colleges to set a standard to which all schools can come.

One of the reasons that Latin is not studied so much as it was, is that it is a difficult study; it involves hard work. The average boy follows the line of least resistance. The teacher can do much in urging him on, but as a general thing if he has not a liking for Latin he will not study it very long.

Another thing that has contributed somewhat to the falling off in the number of Latin students in the schools has been, perhaps, the great advance in standards of scholarship. We have been unconsciously demanding of students in Latin a little more each year than we demanded the year before. Better results are secured, but at the cost of driving away thousands at the end of the first or the second year who ought not to go.

An exaggerated idea of the importance of classical scholarship, and especially of its philological aspects, often becomes the most dangerous for the spread of classical culture.

There are other causes contributing to the general results. They have been well indicated in Mr. MacKenzie's remarks this morning.

But if we are to seek the real cause of the change, we must find it in the action recently taken by many institutions in the requirements for the A. B. degree. Classical study has thus been cruelly wounded in the house of its friends. No more fatal blow to real scholarship was ever struck than the act of many institutions in cheapening this degree by granting it—the degree which has always stood for solid attainments—for work that may be said without exaggeration to stand,

so far as absolute requirements are concerned, for glittering generalities.

But facts are more convincing that theories.

It was my duty something more than a year ago, as a member of a committee of the North Central Association of Colleges and Secondary Schools, to compile the requirements for admission, and for graduation with the A. B. degree, of a large number of colleges both within and without the association. On reading the facts of Mr. Swain's paper, I was immediately struck with certain coincidences. When you see what these coincidences are, you will doubtless be convinced that they are really cause and effect, and not mere coincidences.

The tables here presented are from the report of the Committee in the Proceedings of the North Central Association for the year 1905:

INSTITUTIONS IN NORTH CENTRAL ASSOCIATION—INSTITUTIONS REQUIRING LATIN AND GREEK FOR ADMISSION

	Latin Units.	Greek Units.
University of Chicago	4 (or 2)	2
Denison University	4	2
Drury College	4	2½
State University of Iowa	4	3 (May be done in college)
Iowa College	4	3
Missouri Valley College	3	2 (?)
Ohio Wesleyan University	4	3
Park College	4	2

REQUIRING LATIN.

	Latin Units.	
Colorado College	2	French or German, 2.
Cornell College	4	French or German or Greek, 2.
Knox College	4	
Lake Forest College	2	Other language, 2
Miami University	2	
Milwaukee-Downer College	4	Other language, 2
University of Nebraska	2	Other language, 1.
Northwestern University	4	(or Greek). Other language, 2.
Oberlin College	2	(or Greek). Other language, 2.
Olivet College	2	
Ripon College	4	Greek or German, 2.
Washington University	4	Other language, 2.
Western Reserve University	4	Other language, 3.

REQUIRING LANGUAGE, BUT NOT NECESSARILY LATIN OR GREEK

	Units.	
Albion College	2	
Beloit College	2	
University of Cincinnati	4	or 8.
University of Colorado	4	Latin preferred.
University of Illinois	2	for A. B. in Literature and Arts; not for A. B. in Science.
Indiana University	3	in one language.
University of Kansas	3	
University of Michigan	2	
University of Missouri	2	
Ohio State University	6	(?).
Wabash College	3	
University of Wisconsin	2	

REQUIRING NO LANGUAGE.

University of Minnesota.

INSTITUTIONS NOT MEMBERS OF N. C. A. REQUIRING LATIN AND GREEK

	Latin Units.	Greek Units.
Colgate University	4	3
Princeton University	4	3
University of Pennsylvania	4	3
Syracuse University	4	3
Trinity College	4	3
Union University	4	3
Wesleyan University	4	3

REQUIRING LATIN.

	Latin Units.	
Amherst College	4	Greek or French or German, 2.
Boston University	4	Greek or French or German, 3.
Bowdoin College	4	Greek or French or German, 3.
Brown University	4	Greek or French or German, 2.
Dartmouth College	4	Greek 3, or French or German, 2.
Harvard University	4	French or German, 2.
Johns Hopkins University	4	Greek or French or German, 3.
Mount Holyoke College	4	Greek or French or German, 3
Smith College	4	Greek or French or German, 3.
Tufts College	4	
Vassar College	4	Greek or French or German, 3.
Wellesley College	4	Greek or French or German, 3.
Williams College	4	Greek or French or German, 3.
Yale University	4	Other language, 3.

REQUIRING LANGUAGE, BUT NOT NECESSARILY LATIN OR GREEK

	Units.
Columbia University	4
Cornell University	6

Mr. Swain's tables show that there has been a remarkable decrease in the number of students in high schools taking Latin, and especially that in Michigan, Minnesota, and Wisconsin there has been a startling decrease in the number of graduates having four years of Latin. Inspection of the North Central tables shows at once that in these states the state universities, and in their wake the smaller colleges of the state, have deserted the four-year entrance requirement in Latin for candidates for the A. B. degree.

In Iowa, there has been an increase in four-year Latin students. There we find the State University, Cornell College and Iowa College holding strictly to the four-year requirement.

Indiana shows a smaller decrease in the total number enrolled in Latin, and retains a much larger percentage of graduates taking four years of Latin than does Michigan. Here we find the State University and Wabash College demanding three years of one language. Experience shows that with this requirement Latin is the language usually taken.

In Illinois in the schools quoted, there is an increase in the number taking Latin, with a small decrease in the number of graduates with four years of Latin. These schools are largely in the northern part of the state, and here we find The University of Chicago, and Northwestern University, requiring four years of Latin.

In Ohio there has been an increase in the number taking Latin and a small decrease in those on the four-year basis. Here we find Western Reserve University, and Ohio Wesleyan University, requiring four years of Latin, the State University requiring six years of languages, which practically means Latin for four years, and the great influence of the eastern colleges on this, the most eastern of our states, all working together to upbuild the old standard of at least four years of preparatory Latin for the A. B. degree.

It seems impossible that anyone comparing the facts of Mr. Swain's paper with the facts of the North Central Association report can fail to convict the colleges of the Middle West of being the real foes of classical culture, responsible for the present lowering of standards in the high schools of the section. The unit system ungoverned, founded on the theory that anything under the sun in education is as valuable as anything else, is leading our boys and girls to seek easy "snap" courses which will admit them to many institutions whose well oiled doors swing open all too easily.

The question was asked whether Mr. Bliss would advocate the recognition of a single unit in Latin as a college preparatory subject.

Mr. Bliss placed the following table on the blackboard and continued as follows: Mathematics, 3; English, 3; Physics, 1; English Literature, 1; Physiography, 1; Chemistry, 1; Zoology, 1; Botany, 1; History, 1; a language (Latin, French, or German), 2.

This scheme of requirements is a possible one for admission to the university at the present time. It goes as far in recognizing single units as would seem safe or wise. It might be well for the university to follow the example of some eastern colleges and recognize a single unit of French or German, provided it is a third language; but otherwise the wisdom of the single unit seems doubtful. Too many single units mean dissipation of energy. What is needed is concentrated effort along definite lines of work, continuity, the power of sustained effort.

The school men are only too eager to demand this work of their students. If the colleges will set the standard, the schools will have no trouble in meeting it.

IV.

BY SUPERINTENDENT W. G. COBURN, BATTLE CREEK

I inferred from Professor Kelsey, when he asked me to discuss the excellent paper of Principal Swain entitled "Is Latin Holding Its Own in Public High Schools?" that he wished me to consider the question from the standpoint of our own schools; so I shall limit myself to the discussion of the subject in relation to our city, making only such comparisons and considering such conditions as my limited time will permit.

In some respects the Battle Creek High School has been particularly fortunate and because of certain favorable conditions, we should expect that Latin had suffered but little in recent years: First, the city is pre-eminently a city of the middle class, there being few of the extremely poor or the extremely wealthy. This middle class contains but little foreign element and is made up mostly of mechanics who are perhaps above the average intelligence of the wage earner.

Besides this, the traditions of the high school have been toward the classical course, and these traditions have been fostered and strengthened under the principalship of such men as Professor Hill, of Orchard Lake; Mr. Halsey, of Chicago; Professor Drake, of the University of Michigan; Superintendent E. C. Warriner, of Saginaw; and Mr. H. D. Nutt, all of whom were strong classical men. Again, it is possible that some of our students have felt indirectly the influence of such men as Professors Meachem, Hempl, Scott, and Meader, all of whom were graduated from our high school and were faithful adherents of the Latin course.

Our school boards of recent years have been much opposed to the idea of placing a full commercial course in our high school. We offer simply commercial arithmetic and book-keeping and the Board of Education holds that stenography and typewriting is a profession in itself and should be taught in a professional school or business college.

I mention these facts to show that the conditions are favorable to the study of Latin in our high school, but with all these favorable conditions we can show but one per cent better than the general average of the graduates having four years Latin in Ohio, or 61 per cent to 60 per cent in Ohio. In Indiana 71 per cent of the total enrollment has taken Latin, while we can show but 67 per cent. We find, however, that Indiana has but 34 per cent of the graduates who took four years of Latin. This sudden dropping off of those who take the Latin course caused us to tabulate the number of students of our high school by grades or years, and also by sections as Principal Swain has done. We find that during the past ten years the per cent of enrollment by grades has been as follows:

School Year	Total Enrollment of School.	No. Pupils 1st & 2d Year Latin.	No. Pupils 3d & 4th Year Latin.	Total No. Taking Latin.	Per Cent of Total Enrollment Taking Latin.	Total No. of Grad. for Year.	No. of Grad. who had 4 yrs. Latin.	Per Cent of Grad. who had 4 yrs. Latin.
1895-1896	328	168	42	210	.64	37	25	.67
1896-1897	357	268	67	335	.93	39	16	.40
1897-1898	355	195	67	262	.73	43	34	.79
1898-1899	358	155	58	213	.59	38	22	.58
1899-1900	414	180	21	231	.55	43	26	.60
1900-1901	376	161	48	209	.55	32	20	.62
1901-1902	394	210	71	281	.71	30	26	.72
1902-1903	385	209	67	276	.71	30	21	.70
1903-1904	372	188	62	250	.67	50	24	.48
1904-1905	417	212	41	253	.60	34	21	.62
Totals	3756	1946	574	2520	.67	382	235	.61

Per cent of total enrollment taking Latin for the past ten years:

	9th.	10th.	11th.	12th.	
Total Enrollment	1706	918	646	382	(counting only graduates.)
Total Taking Latin	1305	641	302	235	
Percent. Taking Latin.	76	70	47	61	

Total number of boys and girls who have taken Latin during the past ten years:

9th Grade.			10th Grade.			11th Grade.			12th Grade.		
Boys.	Girls.	Total.	Boys.	Girls.	Total.	Boys.	Girls.	Total.	Boys.	Girls.	Total.
498	807	1305	219	422	641	73	229	302	66	206	272

Why this great falling off at the end of the second year of the high school? The following reasons seem to affect the Latin with us, three of which Principal Swain has already given and Mr. McKenzie and the other speakers have practically covered all the others:

First, The fact that Latin is no longer required for the degree most desired by many prospective college students.

Second, The larger number of electives now offered.

Third, The disinclination on the part of some students to hard work. It is harder to look forward to four years of Latin than to four years of science.

Fourth, All engineering courses of the University of Michigan require but two years of Latin and this has influenced many of our boys to take but the two years of Latin.

Fifth, Better laboratory facilities and more courses in science detract from the study of Latin.

Sixth, A few drop Latin to take up German or French after the second year.

Seventh, The second year Latin is considered by the teachers to be the dullest year in the study of Latin. Many pupils become discouraged.

We urge the bright pupils when in the eighth grade to take the Latin in the high school. We should try to save more at the end of the second year of high school by having the pupils understand better the value of the study of Latin.

The study of Latin should be more attractive. The Latin teacher must compete with the advanced ideas and more attractive ways of presenting the subjects in science, history and mathematics.

V.

BY PRINCIPAL J. R. BISHOP, EASTERN HIGH SCHOOL, DETROIT

Principal Bishop continued the discussion by commenting upon Professor Williams' suggestions and upon the attitude of the Department of Medicine toward Greek. He commended the suggestion of Professor Williams that elementary physics and biology be placed in the second year of the preparatory course, leaving room for a second language beside Latin in the third and fourth years. He assailed the present requirement of physics from all applicants for entrance into all courses of the university. This requirement leads, Dr. Bishop thinks, to confusion of aims, and insincerity and superficiality. The course as at present conducted in Michigan high schools seems to be, on paper, practically a freshman course in physics, laying the foundation for higher work in applied mathematics. It requires much laboratory work and extremely rapid covering of ground in the text book. A few pupils might be expected to compass this work; many of those who now take it because they must, in order to enter the university, show sorry results when closely tested. If an elementary course of physics informational in character, were placed in the second year, it would help make pupils intelligent regarding the modern world of mechanical achievement and not unduly tax their undeveloped powers of observation and research.

IS THE AENEID A COMPLETE POEM?

PRINCIPAL MAUDE A. ISHERWOOD, GRAND HAVEN HIGH SCHOOL

That such a question has been asked is significant. It seems to imply that some one has been dissatisfied with the great Roman epic, that some one has considered that the story of the poem was not finished. We find that it was with none other than the author of the Aeneid himself that this idea originated, for at his death he requested that the poem be burned because he did not consider it finished. It would seem, then, as if there were no question of its incompleteness, but let us ask ourselves what Virgil meant by "not finished."

First, did he consider it incomplete because he intended to add twelve more books? The Iliad has twenty-four books and the Odyssey has twenty-four books. Should the Aeneid also have had twenty-four? We all know that the first six books correspond to the Iliad, while the Odyssey has its counterpart in the last six. It would therefore not seem that Virgil wished to determine the number by the Homeric epic or he would have followed more nearly the outline of its content. Moreover, the number twelve was a significant one for the Romans. There were twelve Tables of the Law and twelve was the basis of their system of decimals.

Suppose, however, that Virgil had intended to write twelve more books. What would have been the nature of the content of these twelve books? In true epic style, Virgil outlines his subject in the first eleven lines: "I sing of arms and the man." The man of course is Aeneas, and the whole poem as it now stands has for its subject "arms and Aeneas." If, however, the story had been continued for twelve more books after Turnus' defeat, the subject could still have been "arms," but the remaining career of Aeneas would have furnished meager material for several more books, and another hero would have been necessary. Following through the other lines of the subject: "Of arms I sing and of the hero who from the coasts of Troy by fate's decree, an exile, first came to Italy and Lavinium's shore, much buffeted both on land and on the deep by violence of the gods to sate vengeful Juno's unrelenting wrath; many hardships also even in war enduring, while he strove to found a city and secure his gods a home in Latium; from him the Latin race, our Alban sires and the walls of lofty Rome." Or, briefly, "I sing of arms and of the hero who came to Italy, endured many hardships in war while he strove to found a city and secure his gods a home." And this is just what Virgil tells in the twelve books of the Aeneid. He tells of Aeneas, his coming to Italy and the trials he endured in war until he found a home for his gods. According to his own outline he did not intend to make the founding of Rome and the growth of Roman empire a part of his poem. He is telling merely the story of the man from whom should spring "the Alban sires, and the walls of lofty Rome." And the twelfth book stops just when a home for the gods had been made in Latium, or, in other words, it stops just where the introductory statement of the subject told us it was to stop.

Again, had another twelve books been added and the history of the Trojans, of their assimilation with the Latins and of the resulting Roman race been fully treated, would not Virgil have been guilty of repetition? For, if we fit together the prophetical passages of the Aeneid we obtain an excellent outline of Roman history. In Book I we find that Aeneas, after carrying on a great war, will establish his people, give laws and rule three years in Latium. After his death Ascanius will rule for thirty years and build Alba Longa where his

descendants will remain for a hundred years until Romulus builds Rome. Book VI gives the outline of the time of the kings, Numa, Tullus, Ancus and the Tarquins, and then adds a list, not chronological of the great men to the time of Virgil—Brutus, who drove out the Tarquins, Cossus, Camillus the Decii, Torquatus, Regulus, the Fabii, the Drusi, Paulus Aemilius, the Scipios, Cæsar and Pompey, while the eighth book adds Catiline and the Battle of Actium and Augustus' glorious career while the death of Marcellus is beautifully told in Book VI. Thus these prophecies, beginning directly after Turnus' death bring the Aeneid to Virgil's day. To be sure, there are prophetical passages which are later fully explained, but how differently they are expressed! They are vague, almost enigmatical, attracting our interest to the final manner of their fulfillment. Among such passages are the curse of the Harpies, the meeting with Scylla. These whet our interest. But those prophetical passages which treat of times not falling within the scope of the subject as outlined by the writer himself are so treated that we are satisfied, that we receive a definite idea of those times—an idea so definite that we know it will not be necessary to add twelve more books to retell them. Therefore Virgil evidently did not mean that he intended to add twelve more books to his Aeneid for the content of those books should and would have had equal mention in the statement of his subject and, secondly he had already covered the remaining period of Roman history by his prophetical passages.

Then, what did Virgil mean when he called the poem unfinished? Perhaps he intended to add some more lines to the last book. Although the twelfth book is now longer than any other, let us try to follow the suggestion. What shall be added? Heyne suggests as closing lines. "Aeneas immediately after this victory received Lavinia in marriage, united his Trojans in one nation with the subjects of Latinus under the common name Latini, built the city of Lavinium and obtained the right of succeeding to the kingdom of Latinus. Thus he secured a dwelling-place in Italy, and introduced his gods into Latium according to the purpose indicated in the beginning of the poem." You remember the close as it now stands, how the two heroes were fighting the finish, how Latinus begs for his life, how Aeneas, seeing the belt of his friend, says that he cannot grant the request and

"Thus as he spoke his sword he drave
With fierce and fiery blow
Thro' the broad chest before him spread;
The stalwart limbs grew cold and dead;
One groan the indignant spirit gave,
Then sought the shades below."

Can you imagine anything so tame as to add that the victor received Lavinia in marriage? Of course he did. Had he not been fighting for her throughout the last six books? Had not the compact been that he who survived the single combat should have her for his wife? Do we

need to have it said that Aeneas unites the Trojans and Latins in one nation? Was not that also a part of the compact? No, that could not have been the intention of a true poet. Virgil neither intended to add twelve more books nor twelve more lines.

There is left then only one possible conclusion as to Virgil's reason for requesting that the manuscript be burned because unfinished. Virgil felt that the Aeneid was not such a perfect work as he would like to hand down to posterity. His ideal was so high, his poetic sense so acute that he felt dissatisfied. We ourselves can sympathize with this feeling when we compare the first books which he had had time to revise with the last and note the higher degree of perfection attained by the revision. Sellar says: "Had Virgil lived to devote three more years to the revisal of his work, there is no reason to suppose that he would have added anything to its substance. Some inconsistencies of statement would have disappeared and some difficulties would have been cleared up. But the chief part of his labor would have been employed in bringing the rhythm and diction of the poem to a more finished perfection than that which they present at present. The unfinished lines in the poem would certainly have been completed and more closely connected with the passages succeeding them." And this is what Virgil meant when he was dissatisfied, and we are convinced that the Aeneid ends just as Virgil wished it to end.

JUVENAL'S TENTH SATIRE AND DR. JOHNSON'S VANITY OF HUMAN WISHES

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In no other age was English literature so affected by Latin as in the eighteenth century. As the hexameter found its perfection in Virgil, so the heroic couplet under the labored efforts of Pope became the model of poetic expression. And likewise in prose we see in Johnson the same finished periods that characterize the writings of Cicero. Though the fundamental causes for this similarity may lie in the social and political conditions of the English people, still a great deal of the likeness is due to the studied imitation of classic models. So close and enthusiatsic was this study that there sprang up a sort of pedantic pride, exhibiting itself in heading poems and chapters, and in scattering profusely throughout a work of prose quotations from the ancients. Naturally there also arose numerous imitations and translations, such as Dryden's Persius and Virgil, Pope's Iliad and Odyssey and his Imitations of Horace, to say nothing of previous attempts such as Oldham's excellent imitations of Juvenal. Thus we see that classical literature had become a vital element of the age.

The last great representative of this period was Samuel Johnson. Like many other learned men of his time, he had a sincere reverence for ancient literature, derived from an extensive and thoughtful reading of classic writers, especially of the Latin. As an example of his conversance with Latin literature, I quote from that inexhaustible biography of Boswell, who, in speaking of Johnson's imitations of Juvenal, says: "I remember when I once regretted to him that he had not given us more of Juvenal's Satires, he said he probably should give more, for he had them all in his head; by which I understood that he had the originals and correspondent allusions floating in his mind, which he could, when he pleased, embody and render permanent without much labor." [Boswell's Life of Johnson, page 63. Globe Edition. Ed. Mowbray Morris. Macmillan & Co. 1903.]

It is to this familiarity with Juvenal that we owe Johnson's London, an imitation of Juvenal's Third Satire, and his more famous imitation of the Tenth Satire, entitled The Vanity of Human Wishes. I have used the word famous, and yet I fear it is more famous than generally familiar. We of later generations have allowed it, and unjustly so, to lie upon our shelves, hidden away in a formidable volume of its author's Rambler, until the title of that volume has grown dim with the dust of years. And yet in spite of the diffidence and ignorance that may exist in regard to it, I make no apology for its resurrection; for the merit it possesses, I believe, will repay us for all the time we devote to it.

My first acquaintance with this poem came after I had read the Latin original; and I was at once struck by the dissimilarity between the two where I had expected to find similarity. I was still further surprised, in reading criticisms, to find that in them all the idea was conveyed that the English poem was a successful imitation of the Latin. This led me to work out a detailed comparison of the two satires, of which this paper is an outline.

Before entering upon the comparison of the two masterpieces, let us see if we can find a dissimilarity in their authors' attitudes toward life which will account for the dissimilarity in the poems. The meagreness of historical evidence relating to the life of Juvenal compels us to judge of him from what he has left written. This judgment is largely personal, depending upon our interpretation of the satires. The prevailing opinion has been, and is shared yet to a large extent, that Juvenal was a stern moralist and a pessimist, railing against all human kind. It is claimed that when he wrote *Facit indignatio versum* [Satire I-79], he meant what he said. But those who maintain this view forget that Juvenal is above all a satirist. Among the very requisites of satire are exaggeration, ridicule, and humor. Take these away and the satire is gone, and what is left is a moral platitude. We can no more expect that Juvenal is sincere in all that he says than we

can suppose that the pictorial satires of today, as depicted in our cartooons, are a true reflection of the artist's beliefs and thoughts.

How can we believe, for example, that Juvenal is sincere in his humorous description of Rome in the Third Satire? "I do not like," says he, "a Greek city. * * * * I cannot lie, nor can I praise a book if it is bad; I cannot tell fortunes by the stars, nor have I ever observed the vitals of frogs." The humor of this lies in its exaggeration; as if all Rome were so filled with foreign upstarts, that the only occupations were those of flatterer, astrologer and soothsayer, in which there was no chance for the sons of Romulus. To interpret these words literally is to destroy the humor. Juvenal realizes the untruth in his statement, just as at heart we all do when we satirically speak of old maids as sour and finicky, or of the proverbial mother-in-law as the incubus of the household. It is this humor, whether it be the humor of wit, exaggeration, or situation, that gives life and zest to Juvenal's satires. It is the one thing that makes him enjoyable, that marks him the true satirist. Indeed satire without humor sinks to mere abuse and invective, or at the best becomes a trite moralism.

This humor in Juvenal crops out everywhere, even in the midst of his serious discourse. Many are the instances where the sudden anti-climax renders the preceding majestic lines nothing but a mock solemnity. And so from the standpoint of the true satirist it is natural to conclude that Juvenal believes but a part of what he says. His sincerity extends only so far as the moral purpose of his satire is concerned. This purpose is only the kernel, around which he heaps a wealth of ridicule, of humorous illustrations and situations. Therefore, in view of Juvenal's wonderful power as a satirist, I cannot believe that he went through life with a grim and foreboding countenance, or that he was, like a cur, always ready with a snarl and a bite. It is more natural to think of him, indeed, as one whose eye was always open to the humorous side of life; whose friends, I imagine, often found him laughing, even though at times the laughter may have been cynical and bitter. It is this shrewd sense of the ridiculous and humorous that characterizes the Tenth Satire, and differentiate it from its imitation by Johnson, to whom we shall now turn our attention.

There is no doubt that Johnson was an out and out pessimist. To read his Rambler is like going to a funeral. His sentences march along in solemn and heavy array, and his thought is fully equal to his style. The following is a quotation from the Rambler, cited by Leslie Stephen in his Life of Johnson [English Men of Letters Series, page 175. Harper Bros. 1878.] It illustrates both his style and his view of life.

"The cure for the greatest part of human miseries is not radical, but palliative. Infelicity is involved in corporeal nature, and interwoven with our being; the armies of pain send their arrows against us on

every side; the choice is only between those which are more or less sharp, or tinged with poison of greater or less malignity; and the strongest armor which reason can supply will only blunt their points, but cannot repel them."

No wonder that the subject, "The Vanity of Human Wishes," which is also the theme of his story of Rasselas, was especially attractive to him. The sentiment of Juvenal's Tenth Satire, therefore, fitted in perfectly with the doctor's state of mind. To Johnson the moral and didactic element in Juvenal overshadowed all else. It was his unswerving rule never to allow much of the lighter vein to creep into anything which he was to offer for publication. As a result his writings are permeated with moral platitudes.

This moralizing of course entered into his conception of poetry. He was of the old school of Dryden and Pope, and so to him the didactic and logical element was the chief characteristic of poetical composition. As Leslie Stephen says, [page 187, in volume cited above], "He always inquires what is the moral of a work of art. * * * * He condemns not only insincerity and affectation of feeling, but all such poetic imagery as does not correspond to the actual prosaic belief of the writer." As a proof of this remark we need only to read Johnson's criticism of Milton's Lycidas in his Lives of the Poets. [Johnson's Lives of the Poets, page 96. Ed. Matthew Arnold. Macmillan & Co. London. 1892.]

"In this poem (Lycidas)," writes Johnson, "there is no nature, for there is no truth; there is no art for there is nothing new. * * * * Its inherent improbability always forces dissatisfaction on the mind." And after a little he quotes Milton's lines, "We drove afield * * * * Battening our flocks with the fresh dews of night," and adds, "We know that they never drove afield; and that they had no flocks to batten;" and still farther down we read, "Nothing can less display knowledge, or less exercise invention, than to tell how a shepherd has lost his companion, and must now feed his flocks alone, without any judge of his skill in piping; and how one god asks another god what is become of Lycidas, and how neither god can tell."

Such is Johnson's conception of poetry. Add to it his pessimistic moralism, and such a poem as The Vanity of Human Wishes becomes the inevitable outgrowth of his state of mind; for, naturally enough, we shall find it a sober, earnest, plodding poem, and yet filled with a dignity of language and thought that places it among the great poems of that school which wrote only in heroic couplets. To expect to find in Johnson the characteristic satire and humor of Juvenal is to presuppose an affinity between them which does not exist. Johnson is always reverent, conservative, sincere, and moralistic, qualities that certainly do not enter into the make-up of a great satirist, such as Juvenal. We are therefore not a little surprised to read in Macaulay's famous essay on Johnson that, "What Pope had done for Horace, John-

son aspired to do for Juvenal. The enterprise was bold, and yet judicious. For between Johnson and Juvenal there was much in common, much more certainly than between Pope and Horace." [Macaulay's Life of Johnson in Matthew Arnold's edition of Johnson's Lives of the Poets, page 12. Macmillan & Co. 1892.] We can indeed agree with Macaulay that "the enterprise was bold;" but that it was "judicious" because of the likeness between Juvenal and Johnson is about as false as to say that Pope's translation of the Iliad and Odyssey was judicious because Pope had much in common with Homer. Let us now see how this judgment concerning Johnson and Juvenal is substantiated by the poems under discussion.

The limitations of space permit me to select only two or three characteristic passages for comparison. As to the poems as a whole, it will be sufficient to say that Johnson has closely followed the structure of Juvenal, using the same logical development, but drawing his illustrations from English life and history. Each satirizes in turn the wish for fortune, power, eloquence or literary fame, military glory, long life, and beauty.

One of the most humorous parts of Juvenal's poem is the satire on the wish for eloquence. Says Juvenal, "Why, even the little school urchins long for the fame of Demosthenes and Cicero, aye, and they keep on longing the whole year round, vacations and all." Then he cites that most wretched and jingling verse from Cicero's poem on his consulship, a verse filled with unbearable conceit, *O fortunatam natam me consule Roman* [Satire X-122]. And Juvenal adds, "If Cicero had written everything as bad as that, he could have scorned the swords of Antony. I should rather have been a ridiculous poetaster than have written thee, O thou divine Philippic of conspicuous fame." And he ends up with the humorous picture of the blear-eyed father of Demosthenes sending his boy from the felicity of a blacksmith shop to the unhappiness of an oratorical career.

But when we have read this passage and enjoyed its fun, we begin to wonder what it is that Juvenal is driving at; for surely eloquence and rhetorical training are worth striving after. Does Juvenal want to take away all intellectual attainment? Does he think his argument is good when he cites two so great careers as those of Cicero and Demosthenes? Almost any school-boy would reply, and justly, too, "Give me their eloquence, their honors, and I'll risk their fate." The whole argument is in fact nothing but pure sophistry. And of course Juvenal knew it was when he wrote it. There are some who will call this pessimism, or perhaps a case of "sour grapes." But Juvenal was a man of too much sense to make seriously such an argument as we find here. We must remember that sophistry is a natural means of satire; and, indeed, to a decided optimist all satire would be more or less sophistical. In fact the whole argument of this poem is based on insufficient evidence. We must dig below this false reasoning of

Juvenal to find the lesson he has for us. Juvenal knows he is exaggerating, but his purpose must be accomplished. What this purpose is we shall see when we come to discuss his conclusions.

The corresponding passage in Johnson consists of thirty-nine lines, over twice as many as Juvenal's. Johnson directs his satire, not against eloquence but against literary and scholarly fame. Unlike Juvenal, he is entirely serious, and, above all, sincere; for his own life was filled with enough hardships and disappointments to afford him sufficient grounds for dissuading against a literary career. Here surely Johnson has selected a much better object for satire than Juvenal; wherefore his reasoning is much the stronger. "Though you should escape all temptations," says Johnson, "and take science captive in her own retreat, * * * *

> Yet hope not life from grief or danger free,
> Nor think the doom of man reversed for thee.
> Deign on the passing world to turn thine eyes,
> And pause a while from letters to be wise;
> Then mark what ills the scholar's life assail,
> Toil, envy, want, the patron, and the jail.
> See nations, slowly wise and meanly just,
> To buried merit raise the tardy bust."

These lines, unlike Juvenal's, enforce our respect. Indeed, we can almost agree with Macaulay in his criticism, when he says, "Johnson's vigorous and pathetic enumeration of the miseries of a literary life must be allowed to be superior to Juvenal's lamentation over the fate of Demosthenes and Cicero." [Page 15, Johnson's Lives of the Poets. Ed. Matthew Arnold. Macmillan & Co. 1892.] Of course in accepting this criticism of Macaulay we are placing Johnson above Juvenal as an earnest and sincere writer, not as a humorous and sophistical satirist; for Johnson's lines are too mild and sober to be called satire. And, too, we hope that Macaulay did not imagine, though I fear he did, that "Juvenal's lamentation over the fate of Demosthenes and Cicero" was a real one, washed with true tears.

Omitting the satire on military life, in which Johnson offsets Juvenal's Hannibal with his famous lines on Charles the Twelfth of Sweden, we come to Juvenal's satire on the wish for long life. To judge from the number of lines (there are a hundred of them, almost a third of the whole poem) and from the wealth of illustration, we might think it was the most important part of the satire in Juvenal's opinion. And perhaps it was, for we have one of the finest examples of his descriptive power, enlivened, as it always is, by his characteristic humor. To be sure the humor is a sort of gruesome thing that jars on our finer sensibilities, and compels us, if we would enjoy it, to keep in abeyance our natural feelings of pity and reverence. "Look at the old fellow," says Juvenal, "He hasn't any skin. It's all hide. See his flabby cheeks, and such wrinkles as only a baboon, sitting in an African jungle, could dig into her pate. He has to munch his food,

for his teeth are gone. Look at his bald head, and his nose drivelling like a baby's. He's a nuisance to his wife, his children, and himself. He's pleased with neither drink nor victuals. He wouldn't start at a blast of trumpets. Around him are leaping a whole tribe of diseases, sciatica, rheumatism, lumbago and I know not what. I could tell more easily how many patients a quack will kill off in an autumn. He's fed as if he were an infant, and stretches his mouth for his food like a young bird goping for the worm in its mother's bill. He has forgotten everything, even how his own children look. And he ends up by becoming the dupe to a pleasing wench. But even if you escape all this," adds Juvenal, "yet your old age will be filled with sorrow over the loss of friends." And he goes on to give us examples, ranging all over the field of mythology and history. Again he breaks forth into his humorous strain, "There's Nestor, who, if what Homer tells us isn't a lie, lived nearly as long as a crow, only at last to complain of the laws of fate and too much thread when he beheld on fire the beard of Antilochus." As further illustrations of a too long life, we have Peleus mourning Achilles; Ulysses mourned by his father; Priam beholding Troy and her woes, and "perishing before the altar of Jove, like an old ox offering up its scrawny neck to its master for slaughter. Yet he died a man's death. But Hecuba, his wife, came to a worse fate; for she lived to turn into a barking cur. Then there was Mithridates and Croesus and our own Marius with their miserable fate. Campania with providential foresight, would have given to Pompey the fevers which he ought to have wished for. But," adds Juvenals with a bitter fling at religion, "the public prayers prevailed, and so he was spared only to be conquered and to lose his head, whereas the Catilinarian conspirators got off with whole carcasses."

Such is Juvenal's attack on the wish for old age. That a large part of it is pure sophistry, is plain enough. If it were all serious argument, for what purpose is all that absurd attempt to convince us with mythological evidence of that which Juvenal himself impugns by his ridicule? The conclusion is obvious enough—Juvenal is satirizing not only the wish for old age, but also incidentally the old belief in legends and myths. And so we cannot think of this tirade against old age in any very serious mood.

Let us now turn to Johnson's version. We find, as we should expect, a very careful and serious argument. It is no joking matter with the doctor. He first describes the ills attendant upon old age, in which you may be sure there is no comparison to a baboon. For Juvenal's humorous description of the old man's loss of hearing, we find in Johnson these affected and verbose lines:

> "Approach, ye minstrels, try the soothing strain,
> Diffuse the tuneful lenitives of pain;
> No sounds, alas! would touch th' impervious ear,
> Though dancing mountains witnessed Orpheus near;
> Nor lute, nor lyre, his feeble powers attend,
> Nor sweeter music of a virtuous friend."

But the next few lines are a decided improvement—

> "But everlasting dictates crowd his tongue,
> Perversely gross, or positively wrong.
> The still returning tale, or lingering jest,
> Perplex the fawning niece and pampered guest,
> While growing hopes scarce awe the gath'ring sneer,
> And scarce a legacy can bribe to hear."

After describing the avarice of old age, a phase which Juvenal neglects, Johnson discusses that old age which by a virtuous life has escaped the usual maladies attending a wicked one. We remember that Juvenal introduces the subject in four words, *ut vigeant sensus animi* [Satire X-240], and then starts in with the catalogue of woes that afflict even such an old age. But Johnson is too conscientious to make any such flippant argument as this. He perceives the injustice in Juvenal's treatment, for he feels that such an old age is not absolutely to be deplored. And so those four words of Juvenal he expands into eight lines—

> "But grant the virtues of a temp'rate prime,
> Bless with an age exempt from scorn and crime;
> An age that melts with unperceiv'd decay,
> And glides in modest innocence away;
> Whose peaceful day benevolence endears;
> Whose night congratulating conscience cheers,
> The gen'ral favorite as the gen'ral friend;
> Such age there is, and who shall wish its end?"

It is here that we see a fundamental difference between Juvenal and Johnson. Juvenal is not at all considerate of either beauty, authority, or reason. Priam is like an old ox, and a virtuous old age has no attractions whatever. The goal is the all in all with Juvenal, and he rides rough shod over everything until he reaches it. There is no logic, it is all force. But Johnson is very careful about what he says. Everything is propped up as he goes along in his slow and positive manner. He cannot dismiss an argument in a line; he must exhaust it and make it convincing. Both men of course knew that there was nothing so very deplorable in the life of a good old man. But Juvenal feels no scruple in utterly ignoring the beauty of such a life; whereas the good old doctor's conscience pricks him. He might meet some of his friends on the street who would take him to task for so unjustly abusing old age. And so he inserts the above lines as a sort of an apology to the succeeding lines, quoted below, in which, by the force of his pessimistic nature, he makes as a serious argument what in Juvenal is a half-hearted and sophistical contention. Says Johnson—

> "Yet even on this her load Misfortune flings,
> To press the weary minutes' flagging wings;
> New sorrow rises as the day returns,
> A sister sickens, or a daughter mourns."

With Johnson the vanity of human wishes is a certainty, and he goes about to prove it with an earnestness and sincerity that cannot be questioned.

And, now, after all this arraignment of human wishes, what inference is induced for us by our pagan and our Christian poet? It would seem from the enobling influences of Christian faith that in the modern poem we should find a rule of life so ideal and beautiful that it needs must far surpass anything that could come from the intellectual and soulless beliefs of ancient philosophy. But to our surprise we find the opposite to be true. The pagan and stoical Juvenal gives us a more helpful and hopeful view of life than does the Christian doctor. And yet this need not surprise us so much; for we see between their conclusions that same difference which we have already noticed in the men themselves. Johnson's pessimism, which dominated in all he ever wrote, draws for us a withering and negative conclusion. Life is a vale of sorrow for man, to whom, as Johnson puts it, "Death is kind nature's signal for retreat." There is nothing positive for man to do in life. He is at the mercy of God, and his only crumb of comfort is that at the end there is some mysterious "best." As we have already noted in the quotation from the Rambler, the cures for human ills are not "radical but palliative." Let man bear it all with passive resignation. The *carpe diem* of Horace was an idea entirely foreign to the doctor's mind. Such is Johnson's philosophy of life. It is Puritanic, but surely it is not Christian. We finish the poem and come away with the funeral knell of life ringing in our ears.

But with Juvenal it is far different. Instead of a passive resignation to a mysterious Providence whose only aid is a shadowy hope of a life to come, we find in the pagan poet that positive and stoic endurance which lifts the individual above his environment, giving him enjoyment of life in spite of the blows of fate. Man's own will, and not death, is the panacea of his woes. To Juvenal the individual is supreme. To be sure he speaks of trusting all to the gods, but almost in the same breath he utters a facetious remark about offering up "the sausages of your little white porker," a joke rather disparaging to the divinities, which may well cast doubts upon the sincerity of Juvenal's religious faith. God to him is rather the personification of will, for he says, "I tell you that which you can do for yourself." Thus does Juvenal consistently with the stoic point of view, make man the arbiter of his own passions, and thus he is able to prefer "the sorrowful labors of Hercules to love and feast and downy couch." Therein lies the secret of happiness. Wish not for glory, or love, or power, but rather for self-control, "a sound mind in a sound body, and a brave spirit free from the terror of death." Is this pessimism? Is Juvenal looking at us with a sour and gloomy countenance? Is it not rather a positive and helpful view of life? Throw around it the softening and supporting influence of Christian love and immortality, and we have a true ideal for which to strive.

Now, having seen the conclusion, we can easily understand the true motive of Juvenal's satire upon human wishes. It is not the particular wish that Juvenal warns us against, but rather

the act of wishing in itself, which is so often a misdirected ambition centering about the individual. And thus we see that the sophistries of such arguments as those against the wish for eloquence and old age are merely that common satirical device by which the satirist impresses more deeply the lesson he wishes to convey. And this lesson, as we have seen, is that the individual should be master of himself rather than yield to the common passions and desires of mankind.

Such is Juvenal's Tenth Satire, and such is Johnson's imitation, The Vanity of Human Wishes. The opinion is prevalent that Johnson's poem is a successful imitation. For example, in the article on Juvenal in Harper's Dictionary of Classical Literature and Antiquities, we read in connection with the Third and Tenth Satires, the following criticism: "It is these two satires that Dr. Samuel Johnson paraphrased in English in his two poems, London and The Vanity of Human Wishes, with a fire and force and epigrammatic terseness of language that are in no respect inferior to the original." Again in the article on Juvenal in the Encyclopædia Britannica (9th edition) we read, "Johnson's imitations of the third and tenth satires in the London and Vanity of Human Wishes will convey to readers ignorant of Latin a good impression of the power of the original." So far as concerns The Vanity of Human Wishes, both these criticisms are misleading and false. As applied to the London they are only partially true, since in that poem Johnson, suppressing his own feelings, has transcribed a portion of the humor and ridicule of the original. As another example of this conventional criticism of Johnson as an imitator of Juvenal, I quote from a note on Juvenal in the explanatory index to an edition of Macaulay's Life of Johnson by A. P. Walker [D. C. Heath & Co. Boston. 1904.], a book used in our secondary schools: "Johnson was preceded in his imitation of the third satire by the English satirist Oldham, and by the French poet Boileau; but Johnson has the best claim to the title of 'the modern Juvenal.'" And Gosse, in his History of Eighteenth Century Literature, says of The Vanity of Human Wishes: "But it is perhaps the most Roman poem in the language, the one which best reflects the moral grandeur of Latin feeling and reflection." [A History of Eighteenth Century Literature, by Edmund Gosse. Macmillan & Co. London. 1901.] All these writers have failed to appreciate the fundamental difference between Juvenal and Johnson. They forget that Juvenal is a satirist, and that Johnson is a moralist. The power of Johnson's poem is due to its sincerity of purpose, and dignity of language. It fails utterly in satirical power, and hence is not a satire, but merely a didactic *tour de force,* a sermon written in rhyme. Take from Juvenal's Tenth Satire all its grotesque terms of expression, its anti-climaxes, its ridicule and its exaggeration, that is, deprive it of the essential features of satire, and then expand what we have left, and we should have something approximating to Johnson's

imitation. We must therefore look upon Johnson's poem as an imitation in form, but not in spirit. We might almost say that Juvenal's poem is a parody of Johnson's. As far as form is concerned Johnson is equal to Juvenal, and at times superior. Juvenal is not so careful about the connection of part to part. For often the wealth of his illustration leads him into disproportion, as is the case with his diatribe against old age. Johnson has, however, elaborated his theme very carefully ,and as a result we have a poem almost as finished in style as are those of Pope. But outside of this form and a certain dignity of expression, a dignity which in Juvenal is often a mere mockery, the likeness ceases between the Latin and the English poem. And, so, as a truthful imitation, The Vanity of Human Wishes is a failure. It is rather, therefore, to be looked upon as an original production, stamped with an individuality, which, if it does not gain our admiration, at least commands our sincere respect.

CONFERENCE OF PHYSICS AND CHEMISTRY

EQUIVALENT WEIGHT OF MAGNESIUM

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This experiment is not given with an idea that it contains anything new or novel, but because it is simple and successful.

A piece of magnesium ribbon 1 meter long is weighed and cut into lengths of 4 cms. each. This is done by the teacher. The pupil fills a 6-inch test tube with water at room temperature and inverts it in an evaporating dish partially filled. One of the small pieces of magnesium, whose weight is now known, is coiled about a rubber band and put under the test tube, the edge of the tube resting upon the rubber band and thus preventing the effervescence of hydrogen from carrying the magnesium into the upper part of the tube (Fig. 1). A few drops of sulphuric acid are poured into the evaporating dish and the hydrogen produced is collected in the tube. After the metal is completely dissolved, the apparatus is allowed to stand for a few minutes to come to the room temperature. Then a label is placed on the tube to indicate the volume of hydrogen, the tube being held steady with a test tube holder to avoid warming the gas by contact with the hands. The volume of hydrogen is obtained by removing the test tube and filling

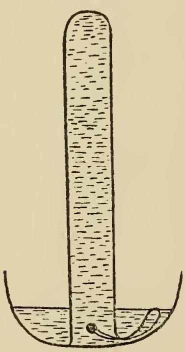

Fig. 1

Fig. 2

it with water from a burrette up to the label (Fig. 2). This volume is reduced to standard conditions and its weight computed. The ratio is then obtained between the weight of magnesium used and the weight of hydrogen obtained. It is seldom that the error amounts to 1 per cent. We find the experiment particularly valuable immediately after studying Boyle's Law and Charles' Law.

ARE THE ELEMENTS TRANSMUTABLE, THE ATOMS DIVISIBLE AND FORMS OF MATTER BUT MODES OF MOTION?

BY PROFESSOR S. LAWRENCE BIGELOW, UNIVERSITY OF MICHIGAN

The advance workers in chemistry and physics are constantly accumulating new facts and propounding new theories which must be digested and incorporated in the body of the sciences. The process of assimilation is often slow, and it is right that new and important facts should be vouched for by more than one investigator, and that a new theory should prove its usefulness, before being placed beside old and tried facts and theories. But too often the effects of the advances are unduly delayed through a reluctance to revise old text-books or old lectures, perhaps not so much because of mere laziness as because of a failure to appreciate the full force of the evidence in favor of new views, or of the advantages to be obtained by their adoption. The fact that the arguments for an innovation, for a time at least, are scattered through many journals, leads to an under-estimate of their cumulative force.

It is the purpose of this article to gather the main facts, some old, many recent, most of them fairly generally known, which are compelling us to alter our old definitions, and to show what a strong argument they make in favor of believing in the transmutation of the elements, the divisibility of the atoms and that what we call matter is simply a mode of motion.

It is interesting to note the caution with which text-books express themselves when it is necessary to give definitions for these terms. By a careful choice of words most authors avoid making false statements, but they certainly do frequently lead their readers to unjustifiable conclusions. For instance, in Roscoe and Schorlemmer's "Treatise on Chemistry, issued in 1891, we find the definition, "An atom is the smallest portion of matter which can enter into a chemical compound." As is the usual custom, the ideas of the alchemists regarding the possibility of transmuting metals is held up to ridicule, and thus, by implication at least, the ultimate nature of the elements and the

idea that the atom is indivisible is infallibly conveyed to the reader. A more recent instance is to be found, even in the late editions, of one of the most widely used texts on general inorganic chemistry. In this book, on page 4, we read, "Molecules may be defined as the smallest particles of matter which can exist in the free state;" on page 5, "Atoms are the smallest particles of matter which can take part in a chemical change;" on page 6, "Molecules consisting of atoms of the same kind are termed elementary molecules, and substances whose molecules are so constituted are known as elements." The numbers of the pages on which these statements occur are also significant. This reminds one of the methods of the old Greek philosophers, who pretended to solve all questions of science by pure deduction, positing some hypothesis, and then developing everything else by meditation in their closets, disdaining to disturb the order of their thoughts by experiments. But it is unworthy of the present age of inductive science, wherein every thought has, or should have, experimental evidence as its starting point. It can not be said that this particular author has made a false statement, but he has left the subject incomplete; cautiously reserving a loophole for his own escape, he fairly traps his readers. For it is inevitable that, with such didactic phraseology, and without having his attention called to the hypothetical, the tentative, nature of these definitions, the student should become convinced that the most fundamental facts of chemistry are that there are about eighty substances so simple that they can never be broken up into simpler things, and that all substances are composed of ultimate particles, called atoms, eternally indivisible.

A student started out with this hodge-podge of fact and theory thoroughly implanted in his mind as the basis for all his future knowledge, is sadly handicapped, indeed he is intellectually maimed, and it may take him years to overcome the habit of confusing fact and theory, and to learn how to think straight; perhaps he never succeeds in overcoming it. This confusing of facts with theories is a vicious habit which grows till it colors all one's thoughts, hinders the free play of the intellect, diminishes the power of right judgment, and starts the ossification of the wits even before the age set by Dr. Osler.

It is not necessary to consider a student of chemistry as an infant in arms to be fed on predigested food. He may be assumed to have a digestive apparatus of his own. Give him the benefit of any doubt and ascribe to him at least a dawning intelligence, which, properly stimulated, may some day shed some light of its own. It is the characteristic course of a lazy teacher, and one pleasing to lazy students as well, to supply a lot of personal opinions in the shape of cut and dried definitions, so easy to memorize and, unfortunately, so hard to forget; phrases which do not require the intellect to bestir itself and exercise its faculty of criticism, to pass judgment for itself between alternative or conflicting views. Strictly speaking, nothing should be presented in

the form of a definition except what is, in itself, a statement of experimental facts, as for instance, we describe or define a unit of measurement in terms of other units. When dealing with a subject where more than one opinion is permissible, all should be stated, or at least, the attention should be directed to the fact that others draw different conclusions from the same premises.

The average student is better able to face issues and weigh arguments than most of us realize, and it is more important to educate those falling below the average in this particular than in any other. We should state the facts and then reason in such a way as to teach students how to think. It is indispensable for them to learn to think for themselves. Great stores of chemical facts are of but little real use, unless accompanied by an ability to adapt and to apply them in new conditions, unforeseen by either teacher or student in school or university days, but surely coming in after life. It is the prime necessity for research work or for originality of any kind, and we all are willing to admit that originality is what should be cultivated.

There is a great difference between the phrases, "elements are substances which can not be broken up" and "elements are substances which we have not as yet succeeded in breaking up," and we should mark well the difference. This caution, lest we slip into the error of stating as fact more than we really know is the distinguishing difference between the chemistry of to-day and the chemistry of a few years ago. It is more than this, it expresses concisely the difference between the way in which any science should be taught and studied, and the way in which it should be neither taught nor studied.

This particular differentiation between two definitions of the term element has been more than justified by the results which have followed the last ten years' work in pure chemistry, spectroscopy, radioactivity and Röntgenology (a term which has been seriously proposed by one of that fraternity which seems to consider its main function in life to be the coinage of new words).

The main arguments which may be marshaled in favor of considering the elements as ultimates, and the atoms as indivisible consist:

First, of all those facts which Dalton condensed into the laws of definite and multiple proportions, and to which there have been as many additions as there have been analyses and syntheses made before or since his time.

Second, Dulong and Petit's law that the atomic heats of all solid elements are the same.

Third, the isomorphism of many compounds containing similar elements, a phenomenon discovered by Mitscherlich.

Fourth, Faraday's law, that equivalent quantities of the elements are deposited at the electrodes during electrolysis.

Truly, an imposing array of evidence, and more than sufficient to justify us in making the assumption that atoms exist. But curiously

enough, there is not one item amongst all these facts compelling us to believe that these atoms are the ultimate constituents, or that they are indivisible. These later hypotheses are purely gratuitous, tacked on by Dalton and retained by succeeding chemists and physicists for no good reason. Perhaps because imitation is a characteristic, inherited from our simian ancestry and is so much easier for us than originality.

Many a chemist looks askance at any tampering with the atoms, apparently fearing that it may hurt them, or even destroy them utterly and the atomic weights with them. Or he trembles for his spidery and tenuous structural formulæ, knowing full well that if deprived of these, he will be irretrievably lost in a labyrinth, without a thread to guide him. While, if he is not permitted to think of the carbon atom as a little chunk of matter, tetrahedral in form, he thinks he is launched on a sea of troubles.

But all this apprehension arises from a misunderstanding. That the atomic weights remain unharmed and unaltered, as the units for chemical calculations, and that nothing which is good or useful about the atomic theory is destroyed or even assailed by the new ideas, that the trend of these new ideas is unmistakably constructive and not destructive, is best shown by a review of the arguments in favor of the hypothesis that the atom is divisible, and that our elements are not elements in the true sense of the word.

There is nothing new in this view; it formed the first article of the faith of the alchemists. It was unqualifiedly denied by Dalton, and fell into such disrepute that even within recent years one risked being called a dreamer, or even a fool, if he dared to consider it possible. Here again is an instance of the desirability of being as precise as possible in the use of terms. Many believe experimental evidence of the complexity of "elementary atoms" and the existence of one "mother substance" must be followed immediately by directions for transforming elements into one another; by the transmutation of baser metals into gold. But these are two wholly distinct propositions. An astronomer might locate a mountain of gold on the surface of the moon, but there would still be a goodly chasm to bridge before he derived much material benefit from his discovery!

The idea that there is one fundamental substance would not down. The hypothesis of the English physician, Prout, is a familiar one. When the atomic weight of hydrogen is set equal to unity, the atomic weights of all the other elements come out remarkably closely to whole numbers. There exist numerous groups of three elements, commonly called Döbereiner's triads, the individual members of one group being similar in their chemical properties, and so related that the atomic weight of the middle member is the arithmetic mean of the atomic weights of the extreme members. These are the facts which led Prout to suggest that there was but one element, namely, hydrogen, the others being complexes containing different quantities of this ultimate substance. It

followed that the differences between the atomic weights and whole numbers were to be ascribed to experimental errors in the determination of these values. The desire to test this hypothesis was one of the chief motives for some of the most careful determinations of atomic weights which have ever been made. These determinations resulted in proving that the divergences of the atomic weights from whole numbers was greater than could be accounted for on the basis of experimental errors. This precluded the possibility that the atom of hydrogen was the common ultimate unit, but did not dispose of the possibility that a half, or quarter, or some other fraction, of the hydrogen atom might play that rôle.

In 1901 Strutt[1] applied the mathematical methods of the theory of probabilities to the most accurately determined atomic weights, and calculated that the chance that they should fall as close to whole numbers as they do was only one in one thousand. The inference from this is that it is not a matter of chance, but that there is a regularity in the atomic weights which we do not understand; a regularity which points to the probability that our elements are complex substances, constructed according to some system, from some simpler substance.

All the facts comprised in that great generalization, the periodic law, which states that the properties of the elements, both chemical and physical, are functions of their atomic weights, and most of them are periodic functions, point unmistakably to the same conclusion.

The evidence from spectroscopic analysis is so abundant that it is not easy to compress it into a few general statements.

In the first place, the spectrum of each of our elements consists of numerous lines, a fact not exactly compatible with the notion of extreme simplicity of the particles emitting the light.

In the second place, one and the same element, contrary to common belief, frequently has two or three distinctly different spectra, the particular spectrum which appears depending upon the pressure and the temperature at which the element is, while emitting the light. In fact the extraordinary spectroscopic results obtained when highly rarefied gases enclosed in tubes (variously called Plücker, Hittorf, Geissler or Crookes tubes) were made luminous by the passage of high potential electricity, induced Crookes to suggest in 1887 a theory that the elements were all built up by gradual condensation with falling temperature from a fundamental substance to which he gave the name protyl.[2]

In the third place, the lines in the spectrum of one element may be separated out into several series. Each line corresponds, as is well known, to light of a definite wave length. The wave lengths of the lines comprised in one series are related to each other in such a way

[1]R. J. Strutt, *Philosophical Magazine,* March, 1901, p. 311.
[2]"The Genesis of the Elements," W. Crookes.

that a general formula may be derived for them. This means that, given some of the lines, the wave lengths, and thus the positions, of other lines belonging in the same series may be calculated. In this way the positions of certain lines for certain elements were foretold. Search failed to reveal all of them in light emitted by the element at any temperature producible in the laboratory. But some of the missing lines have been found in the spectra of the hottest stars, stars far hotter than our sun. At the same time many of the lines obtained by terrestrial means are lacking in the spectra of these stars. We have ample experimental evidence that many complex substances dissociate, as we call it, into less complex substances within the temperature range readily controlled in the laboratory. The inference is right at hand that at extreme, at stellar, temperatures our elements themselves are dissociated into simpler substances. To these substances, our elements, in this other condition, have been given their customary names, but with the prefix proto. Thanks to the introduction of Rowland's diffraction gratings for the study of these spectra, we have observations indicating the existence of proto hydrogen, proto calcium, proto magnesium, proto iron and so on through a list of a dozen or more "proto" elements.[3]

Continuation of the work upon which Crookes was engaged resulted in the discovery of the X-rays by Röntgen in 1895. This date may be said to mark a new era in many of our conceptions regarding the universe about us. To J. J. Thomson, professor of physics at Cambridge, England, we owe the greater part of our present knowledge of the cathode rays. He devised most of the experiments and the ingenious, but strictly logical, reasoning which justify us in supposing that these cathode rays consist of swarms of minute particles, which he called corpuscles (reviving an old term and an old theory of Isaac Newton's); particles moving with velocities approaching that of light, each one carrying a charge of what we call negative electricity. He, and those working with him, determined the quantity of this electrical charge to be the same on each corpuscle, and to be the same as the charge we have good reason to suppose is carried by any monovalent-ion in solution. By several methods the approximate number of these particles in a given volume and the weight of the individual particle were estimated. This weight appears to be about one eight-hundredth of the weight generally ascribed to the hydrogen atom, the lightest of all the atoms. It may be objected that there is no positive proof of the existence of these corpuscles, nor do we know the weight or mass of one of them. That is very true, but neither have we positive proof of the existence of atoms, nor do we know the weight of one atom. We can only say that the evidence makes the existence of these minute

[3]The methods, facts and reasonings relating to this spectroscopic evidence are interestingly given in "Inorganic Evolution," by Sir Norman Lockyer.

individuals, atoms and corpuscles, extremely plausible, and makes one as plausible as the other.

Grant that we have discovered particles—in round numbers one thousandth part the size and weight of the hydrogen atom—the argument is still not complete for the divisibility of the atom. Perhaps we have found a new element. But cathods rays were produced under circumstances where they must have arisen from the cathode itself, and it is hard to escape from the conclusion that the atoms of the cathode disintegrated to a certain extent to furnish these particles. Furthermore, rays have been studied having as their sources different metals under the influence of electrical currents, different metals heated to incandescence, flames of different kinds and ultra-violet light, and these rays appear to consist of corpuscles of the same weight no matter what their source. This makes it difficult to escape from the further conclusion that atoms of a great variety of natures are capable of disintegrating and of furnishing the same product by the disintegration[4]; and this is as much as to say that instead of about eighty different elements we have one "mother substance" and Prout's hypothesis is once more very much alive, somewhat modified it is true and in a new garb, better suited to the present fashions.

It remains to rehearse briefly the evidence to be obtained from radio-active phenomena. In the first place, the rays incessantly sent out from these extraordinary substances consist, at least in part, of rays like the cathode rays, and are streams of the same kind of corpuscles but, on the whole, traveling with greater velocities than the corpuscles of the cathode rays. It has been proved by Rutherford and Soddy that the emission of the radiations from these substances is accompanied by a disintegration, or decay as they describe it, of the substances themselves. These investigators have caught some of the products of this decay and have studied their properties. These products themselves decay, some slowly, some rapidly, sending forth other rays and furnishing new products to decay in turn. Indeed each new issue of a scientific journal for the past few years seems to chronicle the birth, life and death of a fresh radio-active substance. The rate at which new offspring of radium, thorium and allied elements are discovered and studied during their fleeting existences reminds one of nothing so much as the genealogy of Noah, as given in the fifth chapter of Genesis[5].

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[4]Experimental details, and also comprehensive treatments of the subject as a whole and of special parts may be found in three books by J. J. Thomson: "The Discharge of Electricity Through Gases" (based on lectures given at the University of Princeton in October, 1896): "Condition of Electricity Through Gases" (a larger book); "Electricity and Matter" (lectures delivered at Yale University in 1903).

[5]It is an indication of the widespread interest in this subject, and of the activity of the workers in this field, that one journal, in the year 1905, contained no less than 167 abstracts of articles upon radioactive phenomena. E. Rutherford's book, "Radioactivity," 2nd edition, 1905, is a masterly survey of the whole subject.

These products appear to be elements, and this idea that some elements may have existences of but short duration, from a few seconds to many years, is a decidedly novel one. It has been suggested that this may account for some of the vacant spaces in our periodic table of the elements, particularly in the neighborhood of thorium, radium and uranium. Perhaps these spaces never will be occupied except by transients. Indeed it is not impossible that all our elements are mere transients, mere conditions of things, all undergoing change. But there is no immediate danger of their all vanishing away in the form of rays and emanations. Rutherford has calculated that radium will be half transformed in about 1,300 years, that uranium will be half transformed in 6×10^8 years, and thorium in about 2.4×19^9 years. We may safely say the other elements are decaying much more slowly, so we may continue to direct our anxieties towards the probable duration of our coal beds and deposits of iron ore as matters of more present concern.

The objection may be raised that perhaps radium should not be classed as an element, but rather should be considered as an unstable compound in the act of breaking down into its elements. But the answer to this objection is at hand. The evolution of energy accompanying these changes is far in excess of that obtainable from any known chemical process, so far in excess that it is certain we are dealing with a source of energy hitherto unknown to us, with a wholly new class of phenomena. The following quotation from Whetham[6] will convey an adequate conception of the magnitude of the forces at work here.

"It is possible to determine the mass and the velocity of the projected particles, and, therefore, to calculate their kinetic energy. From the principles of the molecular theory, we know that the number of atoms in a gramme of a solid material is about 10^{20}. Four or five successive stages in the disintegration of radium have been recognized, and on the assumption that each of these involves the emission of only one particle, the total energy of radiation which one gramme of radium could furnish if entirely disintegrated seems to be enough to raise the temperature of 10^8 grammes, or about 100 tons of water through one degree centigrade. This is an underestimate; it is possible that it should be increased ten or a hundred times. As a mean value, we may say that, in mechanical units, the energy available for radiation in one ounce of radium is sufficient to raise a weight of something like ten thousand tons one mile high."

Again,

"the energy liberated by a given amount of radioactive change . . . is at least 500,000 times and may be 10,000,000 times, greater than that involved in the most energetic chemical action known."

The theory that the source of most of the sun's energy is a decay of elements analogous to radium, to disintegration of atoms, is acknowledged to account better than any previous theory for the great quantity of this energy which we observe, and for the length of time during which it must have been given off according to the evidences of geology.

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[6]"The Recent Development of Physical Science," W. C. D. Whetham.

There is no chemical reaction which is not hastened or retarded by a change in temperature. In general, the velocity of a chemical reaction is increased by an elevation of the temperature and diminished by a reduction of the temperature. But radium compounds emit their rays undisturbed, at an even, unaltered rate, whether they be heated to a high temperature, or cooled by immersion in liquid hydrogen; and what is perhaps equally striking, whether they are in the solid state or dissolved in some solvent.

In view of such facts as these it is idle to suppose that radium is an unstable compound decomposing into its elements, using the terms compound and element in their usual sense. Conflict as it may with preconceived opinions, we seem forced to concede, not only that the transmutation of the elements is possible, but also that these transmutations are going on under our very eyes.

As has already been pointed out, this does not mean that we shall shortly be able to convert our elements into each other. Far from it, up to the present time we have not the slightest idea how to initiate such a process nor how to stop it. We can not, by any means known to us, even alter the rate at which it proceeds.

Now how shall we fit all these new facts and ideas in with our old ones regarding the elements and atoms, and how many of the old ideas must be discarded? Brief consideration is enough to convince us that very few of the old ideas, in fact none of value, need be sacrificed. We must indeed grant that Dalton's fundamental assumption is false, that the atom, in spite of its name, is divisible and consequently that our elements are not our simplest substances, but decidedly complicated complexes. But all the facts included in the laws of definite and multiple proportions remain fixed and reliable, as indeed must all facts, expressions of actual experimental results, no matter what else varies. And there is not the least necessity for altering the methods of using atomic weights in calculations, nor for ceasing to use structural diagrams and models for molecules. We must merely modify our ideas and definition of an atom, and this modification is in the direction of an advance. We know more about an atom, or think we do.

Assume the inferences from the evidence just reviewed to be correct, and how do they affect our conception of the atom? First of all, our smallest, lightest, simplest atom, that of hydrogen, becomes an aggregation of about eight hundred smaller particles or corpuscles, and the atoms of other elements become aggregations of as many corpuscles as are obtained by multiplying the atomic weight of the element by eight hundred. Thus the atom of mercury must be thought of as containing 800 times 200 or 160,000 corpuscles. Next, the methods by which we believe we can calculate the approximate size of atoms and corpuscles gives us values which enable us to make such comparisons as the following suggested by Sir Oliver Lodge: "The corpuscle is so small as compared to the atom that it, within the atom, may be likened to a mouse

in a cathedral," or "the corpuscle is to the whole atom as the earth and other planets are to the whole solar system."

These corpuscles are probably gyrating about each other, or about some common center, with velocities approaching that of light. It seems needful to suppose this, for it is hard to imagine that the enormous velocities observed could be imparted to a corpuscle at the instant it leaves the atom to become a constituent of a cathode ray. It is more reasonable to imagine that the corpuscle already had this velocity and that it flew off at a tangent owing to some influence we do not understand.

This may appear, after all, to be little more than pushing back our questions one stage, so that the position occupied in our thoughts but yesterday by the atom, is now occupied by the corpuscle. Quite true, but this is in itself a great step, for the advancement of knowledge consists of nothing else than such pushing back of the boundaries. We dare not assume the end is reached, for there is no proof that the corpuscles are ultimate. They mark the present limit of our imaginings based on experiment, but no one can say but what the next century may possibly witness the shattering of the corpuscles into as many parts as it now appears to take to make an atom.

The question is a legitimate one, do we know any more about these "new fangled" corpuscles than we did about the old atoms? The answer is, yes, we probably do. We can go farther in our reasoning on the basis of the properties of the corpuscles, and arrive at results which are startling when heard for the first time.

Lenard[7] has shown that the absorption of cathode rays by different substances is simply proportional to the specific gravity of those substances and independent of their chemical properties. It is even independent of the condition of aggregation, *i. e.,* whether the absorbing substance be investigated as a gas, as a liquid or as a solid. This is another strong argument in favor of the view that there is but one "mother substance" which consists of corpuscles. The corpuscles of the cathode rays must be considered as passing unimpeded through the interstices between the corpuscles of the atom. Lenard calls the corpuscles dynamides and considers them as fields of electrical force with impenetrable central bodies which then constitute actual matter. He calculates the diameter of this center of actual matter as smaller than 0.3×10^{-10}(=0.000,000,000,03) millimeter. Applying these results to the case of the metal platinum, one of the most dense of the metals, one of those with the highest specific gravity, he concludes that a solid cubic meter of platinum is in truth an empty space, with the exception of, at the outside, one cubic millimeter occupied by the actual matter of the dynamides.

If we can thus reasonably and mathematically eliminate the matter

[7] *Wied. Annal.,* 56, p. 255 (1895), and *Drudes Annal.,* 12, 714 (1903).

of a cubic meter of one of our densest metals to such an extent, it should not be very difficult to make one more effort and eliminate that insignificant little cubic millimeter still remaining, and say, with cogent reasons behind us for the statement, that there is no matter at all, but simply energy in motion. This is exactly what has been done by many who occupy high and authoritative positions in the scientific world.

Long before experimental evidence of the existence of corpuscles had been obtained, it was demonstrated that an electrically charged body, moving with high velocity, had an apparent mass greater than its true mass, because of the electrical charge. The faster it moved the greater became its apparent mass or, what comes to the same thing, assuming the electrical charge to remain unaltered, the greater the velocity, the less the mass of the body carrying the charge needed to be to have always the same apparent mass. It was calculated that when the velocity equaled that of light, it was not necessary to assume that the body carrying the charge had any mass at all! In other words, the bit of electric charge moving with the velocity of light, would have weight and all the properties of mass.

This might be looked upon as an interesting mathematical abstraction, but without any practical application, if it were not for the fact that Kaufmann[8] determined the apparent masses of corpuscles shot out from a radium preparation at different velocities, and compared them with the masses calculated on the basis that the whole of the mass was due to the electric charge. The agreement between the observed and calculated values is so close that it leads Thomson to say: "These results support the view that the *whole* mass of these electrified particles arises from their charge."[9]

Then the corpuscles are to be looked upon as nothing but bits of electric charge, not attached to matter at all, just bits of electric charge, nothing more nor less. It is this view which has led to the introduction of the term electron, first proposed by Stoney, to indicate in the name itself the immaterial nature of these ultimates of our present knowledge. We have but to concede the logical sequence of this reasoning, all based on experimental evidence, and the last stronghold of the materialists is carried, and we have a universe of energy in which matter has no necessary part.

If we accept the electron theory, our atoms are to be considered as consisting of bits of electric charge in rapid motion, owing their special properties to the number of such bits within them, and also, no doubt, to the particular orbits described by the electrons. If space permitted it would be interesting to show how admirably the periodicity of the properties of the elements, as expressed in Mendelejeff's table,

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[8] *Phys. Zeitschr.*, 1902, p. 54.
[9] "Electricity and Matter," p. 48.

can be accounted for on the basis of an increasing number of like electrons constituting the atoms of the successive elements. We have molecules consisting, at the simplest, of two such systems within the sphere of each other's attraction, perhaps something as we have double stars in the heavens.

A possible explanation of the puzzling property of valénce is offered, in that an atom less one electron, or plus one electron, may be considered as electrically charged, and therefore capable of attracting other bodies, oppositely charged, to form electrically neutral systems. An atom less two electrons, or with two electrons in excess, would have twice the ability to combine, it would be what we call divalent, and so on. An electronic structure of the atom furnishes a basis from which a plausible explanation of the refraction, polarization and rotation of the plane of polarized light may be logically derived. Hitherto explanations for the observed facts have been either wanting or more or less unsatisfactory. For instance, grant the actual existence of tetrahedral carbon atoms, with different groups, symmetrically arranged at the apices, and yet we can not see any good and valid reason *why* such a structure should be able to rotate the plane of polarized light. Grant that the molecule consists of systems of corpuscles traveling in well-defined orbits, and we see at once how light, consisting of other electrons of the same kind, traversing this maze *must* be influenced.

Adopting this theory of corpuscles or electrons, not a concept of any value need be abandoned. On the contrary, the theory furnishes us with plausible explanations of many facts previously unexplained. Its influence is all in a forward direction, toward a simplification and unification of our knowledge of nature.

A few words must be said regarding the old, the threadbare, argument which, of course, is cited against the electron theory. The materialist says he simply can not accept a theory which obliges him to give up the idea of the existence of matter; he says the table is there because he can see it and feel it and that must end the discussion for any one with common sense and moderately good judgment. Now it is the reverse of common sense to let that end the discussion, and our materialist is pluming himself on precisely those qualities which he most conspicuously lacks. He assumes the obnoxious theory to involve consequences which it does not involve and then condemns it because of those consequences. As a rule it is because he knows little about it, and has thought less, that he assumes the electron theory to be pure idealism in an ingenious disguise, that form of idealism which asserts that there is no universe outside ourselves and that everything is a figment of the imagination of the observer. The electron theory postulates a universe of energy outside ourselves. It does not deny the existence of the table; quite the reverse, it asserts it and then offers a detailed description of it, and why it has the properties which it has. This is more than any materialistic theory can do. The electron theory

affirms the existence of what we ordinarily call matter. It defines, describes, explains these things, ordinarily called matter, in a clear and logical manner, on the basis of experimental evidence, as a *mode of motion.* It opposes the use of the word matter, solely because that word has come to stand, not only for the object, but also for the assumption that there is something there which is not energy.

Another groundless objection is offered by the materialists. They say this electron theory is clever, perhaps plausible, but very vague and hopelessly theoretical. Of course it is theoretical, but it is a theory more intimately connected with experimental facts than any other theory regarding the ultimate constituents. One departs further from known facts in assuming the existence of a something to be called matter. What is this matter which so many insist that we must assume? No one can define it otherwise than in terms of energy. But forms of energy are not matter as the materialist understands the word. Starting with any object and removing one by one its properties, indubitably forms of energy, we are finally left with a blank, a sort of a hole in creation, which the imagination is totally unable to fill in. The last resort is the time-honored definition, "matter is the carrier of energy," but it is impossible to describe it. The assumption that matter exists is made then because there must be a carrier of energy. But why must there be a carrier of energy? This is an assertion, pure and simple, with no experimental backing. Before we have a right to make it we should obtain some matter "strictly pure" and free from any energy, or, at least, we should be able to demonstrate on some object what part of it is the energy and what part the matter, the carrier of the energy. We have not done this, we have never demonstrated anything but forms of energy, and so we have no evidence that there is any such thing as matter. To say that it exists is theorizing without experimental evidence as a basis. The materialistic theory postulates energy and also matter, both theoretical if you will, the electron theory postulates energy only. Therefore the electron theory is the less theoretical and the less vague of the two.

From the philosophical standpoint, having deprived an object of all that we know about it, all forms of energy, there remains what may be called the "residuum of the unknown." We are not justified in saying that nothing remains; we can only say nothing remains which affects, either directly or indirectly, any of our senses through which we become cognizant of the external universe. If the materialist takes the stand that this unknown residuum is what he calls matter, although any other name would be equally appropriate, it must be acknowledged that his position is at present impregnable, and that sort of matter exists. But it is nothing with which experimental science can deal. A fair statement would appear to be: The electron theory accounts for, or may be made to account for, all known facts.

Besides these there is a vast unknown within whose precincts matter may or may not exist.

Michael Faraday is acknowledged to have been one of the ablest of experimenters and clearest of thinkers. His predominant characteristic may be said to be the caution which he used in expressing views reaching beyond the domain of experimental facts. His authority rightly carries great weight and it is therefore of particular significance that he expressed himself more definitely upon these questions than appears to be generally known. In an article published in 1844[10] he says:

"If we must assume at all, as indeed in a branch of knowledge like the present we can hardly help it, then the safest course appears to be to assume as little as possible, and in that respect the atoms of Boscovich appear to me to have a great advantage over the more usual notion. His atoms, if I understand aright, are mere centers of forces or powers, not particles of matter, in which the powers themselves reside. If, in the ordinary view of atoms, we call the particle of matter away from the powers *a*, and the system of powers or forces in and around it *m*, then in Boscovich's theory *a* disappears, or is a mere mathematical point, whilst in the usual notion it is a little unchangeable, impenetrable piece of matter, and *m* is an atmosphere of force grouped around it. . . . To my mind, therefore, the *a* or nucleus vanishes, and the substance consists of the powers or *m;* and indeed what notion can we form of the nucleus independent of its powers? All our perception and knowledge of the atom, and even our fancy, is limited to ideas of its powers: what thought remains on which to hang the imagination of an *a* independent of the acknowledged forces? A mind just entering on the subject may consider it difficult to think of the powers of matter independent of a separate something to be called *the matter*, but it is certainly far more difficult, and indeed impossible, to think of or imagine that *matter* independent of the powers. Now the powers we know and recognize in every phenomenon of the creation, the abstract matter in none; why then assume the existence of that of which we are ignorant, which we can not conceive, and for which there is no philosophical necessity?"

There is a striking analogy between the present condition of our science and our discussions, and those prevailing in the latter half of the eighteenth century when the phlogiston theory was almost universally accepted. We all now believe that heat is a mode of motion and smile at the thought that there were those who considered heat as a material. The materialistic theory is the phlogiston theory of our day and perhaps the time is not far distant when the same indulgent smile will be provoked by the thought that there were those unwilling to believe that matter is a mode of motion.

REFERENCE LIBRARY FOR CHEMISTRY

PROFESSOR B. W. PEET, MICHIGAN STATE NORMAL COLLEGE

The following list of books is submitted as a basis for a chemical library for high schools. The titles mentioned have been selected in the main with reference to the needs of the teacher, although a number are also adapted to the use of the pupils. The books have been

[10]"Experimental Researches in Electricity," Michael Faraday, Vol. 2, pp. 289-91.

classified and only a comparatively few are placed under each heading. It seemed advisable to limit the number yet include the most of the best books published. The list has been submitted to several university professors and high school teachers of chemistry and has in general met their approval.

Beginning students can make little use of reference books until they have acquired some knowledge of the general principles of chemistry, so it is recommended that students not be asked to make any special study of reference books until the second half of the first year's work.

BIBLIOGRAPHY.

I. HIGH SCHOOL TEXTS.

Essentials of Chemistry, Hesseler and Smith. 405 pages. Benj. H. Sanborn & Co., Chicago .... $ 1.20
Descriptive Chemistry, Newell. 590 pages. D. C. Heath & Co.......... 1.20
Elementary Chemistry, Linebarger. Rand, McNally & Co.......... 1.00
Elementary Chemistry, Bradbury. 486 pages. D. Appleton & Co.......... 1.20
Modern Chemistry, Peters. 412 pages. Maynard, Merrill & Co.......... 1.00
Introduction to the Study of Chemistry, Remsen. (New edition, 1906.) 516 pages. (Briefer course). Henry Holt & Co. 1.12
Elementary Inorganic Chemistry, Newth. 288 pages. Longmans, Green & Co.. .90
Experimental Chemistry, Newell. 410 pages. D. C. Heath & Co.......... 1.10
Elementary Principles of Chemistry, Young. 358 pages. D. Appleton & Co.... 1.20
Elementary Manual of Chemistry, Storer and Lindsay. 453 pages. American Book Co. 1.20

II. LARGE DESCRIPTIVE.

An Introduction to General Inorganic Chemistry, Alex. Smith. pp. XVIII plus 780. Century Co. .... $ 2.25
Outlines of Inorganic Chemistry, Gooch and Walker. 514 pages. Macmillan Co. 1.75
Text-Book of Inorganic Chemistry, Newth. 602 pages. Longmans, Green & Co. 1.75
Text-Book of Inorganic Chemistry, Holleman. 458 pages. John Wiley & Sons 2.50
Inorganic Chemistry, Advanced Course, Remsen. 850 pages. Henry Holt & Co. 2.80
General Inorganic Chemistry, Freer. 559 pages. Allyn & Bacon, Boston...... 3.00
The Principles of Inorganic Chemistry, Ostwald. Translated by Alexander Findlay. 785 pages. Macmillan Co. 6.00
Treatise on Chemistry, Roscoe and Schorlemmer, Vols. I and II. New edition. (Inorganic.) D. Appleton & Co. 8.00

III. ANALYTICAL.

Qualitative Chemical Analysis, Prescott and Johnson. 420 pages. D. Van Nostrand Co., New York .... $ 3.50
Qualitative Chemical Analysis, A. A. Noyes. 89 pages. MacMillan Co.......... 1.25
The Principles of Qualitative Analysis from the Standpoint of the Theory of Electrolytic Dissociation and the Law of Mass Action, Dr. Wilhelm Boettger. Translated by Wm. G. Smeston. P. Blakiston's Son & Co. Out soon.
Analytical Chemistry; Qualitative Analysis, Treadwell. Translated by Hall. 466 pages. John Wiley & Sons 3.00
Quantitative Chemical Analysis, Olsen. 513 pages. D. Van Nostrand Co., New York 4.00
Quantitative Chemical Analysis, Clowes and Coleman. 602 pages. P. Blakiston Co., Philadelphia 3.50
Analytical Chemistry. Quantitative Analysis, Treadwell. Translated by Wm. Hall. 654 pages 4.00

IV. DICTIONARIES.

Dictionary of Chemistry, Watts. 4 Vols. Longmans, Green & Co.	$65.00
A Dictionary of Chemical Solubilities, Comey. 515 pages. Macmillan Co.	5.00
The Chemists' Pocket Manual. Chemical Pub. Co., Easton, Pa.	2.00

V. THEORETICAL AND PHYSICAL.

Introduction to Physical Chemistry, Walker. 332 pages. Macmillan & Co.	$ 2.50
The Elements of Physical Chemistry, Jones. Macmillan Co.	4.00
Chemical Theory for Beginners, Dobbin & Walker. 236 pages. Macmillan Co.	.70
Physical Chemistry for Beginners, VanDeventer. Translated by Boltwood. 154 pages. John Wiley & Sons, New York	1.50
Theoretical Chemistry, from standpoint of Avogadro's Rule, Nernst. Macmillan Co.	5.00
Elements of Physical Chemistry, Morgan. John Wiley & Sons	2.00

VI. HISTORICAL.

History of Chemistry, Von Meyer. Translated by McGowan. 544 pages. Macmillan Co.	$ 4.50
History of Chemistry, Venable. 172 pages. D. C. Heath & Co.	1.00
Heroes of Science—Chemists, Muir. 350 pages. Thomas Nelson & Son	1.50
History of Chemistry, Landenburg. Translated by Dobbin. 373 pages. University of Chicago Press	1.75
Essays in Historical Chemistry, Thorpe. 381 pages. Macmillan Co.	2.25

VII. ORGANIC.

Organic Chemistry, Perkin and Kipping. 552 pages (2 vols.) J. D. Lippincott Co., Philadelphia	$ 2.00
Organic Chemistry, Remsen. 364 pages. D. C. Heath & Co.	1.30
Organic Chemistry, Richter-Smith. (2 vols.) P. Blakiston Co., Philadelphia	6.00

VIII. MISCELLANEOUS.

Outlines of Industrial Chemistry, F. H. Thorp. 528 pages. Macmillan Co.	$ 3.30
Methods of Glass Blowing, Shenstone. 96 pages. Longmans, Green & Co.	.50
Chemistry of Daily Life, Lasser-Cohn. J. B. Lippincott Co.	1.75
The Teaching of Chemistry and Physics, Smith & Hall. 377 pages. Longmans, Green & Co.	1.50
Chemical Lecture Experiments, Benedict. 476 pages. Macmillan	$ 2.00
Conversations on Chemistry, Part I, Ostwald. Translated by Elizabeth Ramsey. John Wiley & Sons. 250 pages	1.50
Conversations on Chemistry, Part II. Translated by S. K. Turnbull. 373 pages. Wiley & Sons	1.50
Chemistry of Plant and Animal Life, Snyder. 406 pages. Macmillan Co.	1.40
Story of a Piece of Coal, Martin. 165 pages. D. Appleton & Co.	.40

IX. PERIODIQALS.

School Science, 440 Kenwood Terrace, Chicago. Monthly. October to June, inclusive	$ 2.00 per year
Journal of the American Chemical Society, Eschenbach Printing Co., Easton, Pa. Monthly	6.00 per year
Science, 41 North Queen St., Lancaster, Pa., or 66 Fifth Ave., New York. Weekly	5.00 per year
Science Abstracts	
Engineering Index	
Scientific American	

DISCUSSION OF LIST

A few of the recently published high school texts are very valuable reference books for students to use along with their own text, and they can usually be obtained for such purpose gratis of the publishers.

LARGE DESCRIPTIVE

The most useful and extensive work of reference is the inorganic portion of Roscoe and Schorlemmer's Treatise on Chemistry. It deals with the historical, descriptive and theoretical parts of nearly all chemical subjects. The first two volumes have recently been revised.

The other books mentioned under "Large Descriptive" are university texts. Newth is noted for its attention to industries, Holleman for the interweaving of the Electrolytic Dissociation Theory with the descriptive and theoretical part in a simple way, Remsen and Freer for lucidity and discussion of general relations. The tables of comparisons of the elements in the various families and the discussion of the periodic law are well represented in Freer. Ostwald's Principles of Inorganic Chemistry is a modern classic and should be in the hands of every teacher who can afford it. The new notions and theories of scientific chemistry are very cleverly presented. The author has taken particular care in the development of the conception of ions. It is a text book of *pure* chemistry, so little attention is given to the related sciences and arts.

Every teacher of chemistry should have access to Alexander Smith's Introduction to General Inorganic Chemistry (just published). It is full of good ideas and methods of teaching different subjects. The chapters on Solution, Chemical Equilibrium, Dissociation in Solution, Electrolysis, Chemical Behavior of Ionic Substances are intensely interesting and well written. The theoretical side of chemistry is as clearly presented here as in any book on the market and it is up to date. The book contains about eighty pages of matter in smaller type which is especially for teachers and contains discussions of many points upon which teachers find difficulty in getting information, and also discussion of subjects upon which teachers are apt to go astray.

ANALYTICAL

Prescott & Johnson's book is noted for the number of balanced equations and explanations of chemical reactions. Treadwell's Qualitative Analysis is a recent book and is generally considered an excellent one. The descriptions of the operations are full and clear, the equations are very fully treated and the treatment of acids is unusually extensive. The author utilizes the theory of electrolytic dissociation, mass action and hydrolysis, and explains their relations to analysis, Fresenius was long considered the best text book on Qualitative Analysis, but it is not now generally thought of as up to date, so it is not included in the list. One of the most recent books on qualitative analysis is Boettger's, now being translated by Wm. G. Smeaton of the University of Michigan. It makes practical application of the dissociation theory in the study of the metals.

If one wishes a book on quantitative analysis that describes methods of manipulation in detail and at the same time includes a com-

pilation of the best methods of analysis, both Olsen and Clowes and Coleman are highly recommended. Olsen is more recent and seems to be the favorite in this country so far as it is known. In the back part of the book are chapters on water, gas, coal, iron and steel analysis.

DICTIONARIES

Watt's Dictionary of four volumes contains articles, varying in length from a few lines to several pages, on nearly every chemical substance and every topic in scientific chemistry. It is often convenient to have a reference book on the solubility of chemical compounds to check results obtained by experiments in the laboratory or to aid one in making up solutions. Comey's dictionary is recommended. Meade's Pocket Manual contains many valuable tables and much general information.

THEORETICAL AND PHYSICAL

The books on Theoretical and Physical Chemistry are recommended for the use of the teachers of chemistry only. All that is necessary for students' use can be found in any good college text-book such as Alexander Smith's or Holleman's. Walker's Physical Chemistry is clear and more easily understood than most of the books on the market. The revised edition of Morgan is also very readable and a general favorite. Dobbin and Walker and VanDeventor are elementary. Jones is more complete, not so easy to comprehend but a very valuable reference book.

HISTORICAL

No chemical library would be complete without some book on historical chemistry. A fund of information can be obtained here for making the every day lessons interesting. The teacher as well as the pupil will get a more comprehensive view of chemistry by knowing the struggles and failures and triumphs of the men who have made the science for us.

A very satisfactory book is Ladenburg's, translated by Dobbin. It is a compilation of a course of lectures, and is presented in an interesting style. If one wishes a more complete treatise, VonMeyer is excellent. A very brief but reliable history of chemistry is Venable's. Heroes of Science by Muir, and Essays in Historical Chemistry by Thorpe take up only a few subjects but they both read like romance and the pupil, as well as the teacher, will read them with delight.

ORGANIC

A very satisfactory reference book on Organic Chemistry is Perkin & Kipping's. Remsen is very good, but it is often so brief that parts are not easily understood. Remsen is desirable, however, because it is so full of easy experiments to illustrate many subjects. A very comprehensive view of the carbon compounds is to be found in Richter-

Smith's book. The student and the teacher, with little preparation in organic chemistry, will probably get the most satisfaction from Perkin & Kipping's two volumes.

MISCELLANEOUS

The industrial or practical side of chemistry always appeals to the average student. Thorp's book seems to be a general favorite. It requires but little encouragement to make the pupils anxious to read about the great chemical industries, such as the manufacture of soap, cooking soda, sulphuric acid and the metallurgy of iron. This book should be in every chemical library.

The Chemistry of Daily Life by Lasser-Cohn and The Chemistry of Plant and Animal Life by Snyder are intensely interesting and practical. The latter book deals with the chemistry of digestion, of foods and the rational feeding of animals, including men.

Every wide-awake teacher should have access to the Teaching of Chemistry and Physics, by Smith and Hall. It is full of suggestions on instruction in the class room and laboratory, tells how to present many difficult subjects and discusses the equipment of laboratories and lecture room.

Conversations on Chemistry, volumes 1 and 2, by Ostwald, are written in the form of a dialogue between the master and pupil. The teacher will get valuable ideas of presenting many difficult subjects to his students by reading these books. He is taught to realize the hard things from the pupils' standpoint.

It will add much interest to the development of any subject to illustrate it with other experiments than the ones given in the text or laboratory manual. Some such reference book as Benedict's Chemical Lecture Experiments is very desirable. It is full of interesting experiments on most topics in inorganic chemistry.

The best way to keep in touch with what is going on in the chemical world is to read at least one journal. The Journal of the American Chemical Society is highly recommended because of the review given in each number of the leading articles appearing in different journals and also the mention and review of the books published on chemistry.

School Science contains articles on all branches of science taught in the public schools, including mathematics. It is a magazine especially for the teachers of high schools, and no high school library should be without it. In addition to the valuable and often very practical articles written by university professors and high school teachers of prominence, brief reports of the science meetings in various parts of the United States are given.

The busy science teacher is too often satisfied to confine himself to the texts in use and pays little attention to what is being done in the scientific world. No progressive teacher, no matter what his salary may be, can afford to be without access to some science journal. It gives him inspiration to do better work, it keeps his mind more

active, it helps more than any one thing to keep him out of a rut. It is not so important what journal the teacher reads, but read some good one and keep in touch with the scientific spirit of the time.

In conclusion let me emphasize that the teacher of chemistry cannot do his duty unless he has access to at least one good reference book in each of the main branches into which the science is divided, namely; inorganic, organic, analytical, historical, physical and industrial, and also reads some good science journal.

AN EXPERIMENT TO DETERMINE THE EQUIVALENT WEIGHT OF MAGNESIUM.

RICHARD R. PUTNAM, EASTERN HIGH SCHOOL, DETROIT.

In this experiment any form of alkalimeter may be used. The whole experiment is carried out exactly as in the determination of carbon dioxide with the same instrument. About 0.5 g. of magnesium is put into the alkalimeter along with a little water. The acid used is concentrated sulphuric.

If the results of this experiment are used in connection with those of the experiment described by Mr. Clemens, it is obvious that the volume of 1 g. of hydrogen, and the weight of 1 litre of hydrogen can be calculated.

A SERIES OF COMBINING WEIGHT DETERMINATIONS.

JOHN WALKER MATTHEWS, WESTERN HIGH SCHOOL, DETROIT.

This series of experiments gives the pupil a good practical idea of the different ways in which the equivalent weights of the elements are determined and fixes, also, the fact in the mind that much care and patience is necessary in getting anything like quantitative results in laboratory work.

The pupil first determines the equivalent weight of sodium by replacing one atom of hydrogen of water with the metal sodium. This is done by first filling an 100 c.c graduate with water and inverting over water in the pneumatic trough. Next he weighs a bright piece of sodium, say .11 gr., and wraps it in wire gauze and inserts it in under the graduate in the pneumatic trough. The volume of gas in the graduate reduced to standard conditions of temperature and pressure was found to be 53.8 c.c. Reducing this volume to weight gives .00482 gr. Then from the proportion .00482:.11:1:x. he obtains

22.71 as the equivalent weight of sodium. The true weight, H. as standard, is 22.88, or 23 for practical purposes.

He is next required to determine the equivalent weight of zinc by replacing the hydrogen of hydrochloric acid. The zinc foil used was found to contain about 8½% of foreign matter, hence this per cent. of weight was deducted from the first weight .295 gr. which leaves .27 gr. of zinc. The 100 c.c. graduate was again filled over the pneumatic trough and then a large test tube was filled with 30% hydrochloric acid and the zinc introduced into the acid and the delivery tube placed under the graduate. The volume of hydrogen then reduced to standard conditions and weight gave .00837 gr. Forming the proportion .00837 :27 : :1 :x the equivalent weight of zinc was found to be 32.2.

The next experiment was to find the equivalent weight of silver by substituting the known zinc in place of the silver of silver nitrate. The zinc was weighed out as before and the foreign matter deducted which left .44 gr. Placing the zinc in a test tube and adding the strong solution of silver nitrate it was left until all of the zinc had disappeared. Then it was washed through several waters and the solution decanted in order to remove the excess of silver nitrate leaving the silver precipitate. This was placed into the drying oven and heated to 220° C. for 40 minutes, allowed to cool and weighed. Deducting the weight of test tube and foreign matter the silver was found to weigh 1.47 gr. Forming the proportion .44 :1.47 : :32.2 :x the equivalent weight of silver was found to be 107.5.

Of course there are many chances for the pupil to make errors and it does not take much of an error to throw the result off enough to make the experiment of no quantitative value, yet there is much to gain in working such experiments for the qualitative value. I am of the opinion that we are wasting much time and energy of pupils and teachers in requiring High School pupils to try to determine very many quantitative results during the first semester of work in chemistry. What quantitative work is done should be in the second semester, and that of such nature as would lead to general principles, and not of a technical nature. There should be more interest aroused in the pupils for the subject of chemistry itself, and not to be taken as mere filling out of course and hours' credit. Such topics as the "Bread We Eat," "Digestion of Foods," "Manufacture of Baking Powder," "Soap," "Gas," "Dyestuff," "Paints," etc., and more time given to the identification of elements would tend to bring out this interest.

As chemistry is taught in the high school today it leads to nothing and counts for nothing. The pupil having had a year of the subject goes to college and is not recognized as having had any of the subject, but takes the same work as the pupil entering without chemistry. There is wrong somewhere. Either the teachers of chemistry are not worthy the name or the pupil is wasting time, and it would

seem to be a good subject to discuss in a meeting like this to find out where the wrong is.

It also seems wrong to me to spend so much time in sciences in the high school for preparing pupils for college entrance to the detriment of those who do not go to college. This is not only true of chemistry but of physics and botany also. Our high school physics is applied mathematics, and our botany a course with the microscope. This is all right for one-tenth, say, of our pupils, but nine-tenths of them do not and can not become interested in so much technical work.

A METHOD OF CLASSIFYING THE INORGANIC ACIDS FOR ANALYSIS.

W. S. LEAVENWORTH, OLIVET COLLEGE.

It is safe to assert that an entirely satisfactory method for the analysis of the acids is yet to be formulated. The following method is one which I have used with my students in a more or less modified form for several years with good results, and I venture to present it, thinking it may interest those who are teachers of chemistry.

As we all know the separation of the acids is not as easily effected as the separation of the bases, since their grouping is not so distinct and since they are not so readily separated by precipitation and filtration.

In this classification the groups of the acids are successively precipitated and separated by the use of solutions of the salts of an organic acid, thus eliminating the use of an inorganic acid. This method includes the detection of some twenty inorganic and a few organic acids.

PREPARATION OF THE SOLUTION

If necessary treat the solution with H_2S to remove the metals of the first two groups. Filter, boil to expel H_2S gas from the filtrate and add a slight excess of Na_2CO_3.

Boil, filter while hot, wash and reserve the precipitate which may contain silicic, phosphoric and oxalic acids.

The filtrate contains all the acids present except the silicates, phosphates, oxalates and perhaps the fluorides. While still hot expel from the filtrate the excess of CO_2 by acidifying with acetic acid and finally neutralize the solution with the least possible amount of NH_4OH.

EXAMINATION OF THE NA_2CO_3 PRECIPITATE FOR SILICIC, PHOSPHORIC, AND OXALIC ACIDS

Treat one portion of the precipitate with HNO_3 and evaporate the solution to dryness. Digest the residue with water, add HNO_3, and filter. A white, gritty powder which, when fused in a bead of "micro-

cosmic salt," dissolves and floats in the bead, shows the presence of silicic acid.

To the above filtrate add an excess of ammonium molybdate in nitric acid, warm and let the test stand. The formation of yellow crystalline ammonium phosphomolybdate, shows the presence of phosphoric acid.

Treat another portion of the precipitate with acetic acid and filter to remove any insoluble residue. Boil the filtrate to remove all traces of CO_2 and then add $CaSO_4$ or $CaCl_2$. A white powdery precipitate shows the presence of oxalic acid. If a fluoride were present the precipitate with these reagents would be gelatinous and nearly colorless.

If silicates and fluorides are both present ,they will likely combine forming either silicon fluorides or hydrofluosilicic acid.

GROUPS OF THE ACIDS

Group I

Acids decomposed by the stable mineral acids with the evolution of a gas.

Carbonic—Evolves CO_2, which clouds lime water.
Sulphurous—Evolves SO_2, which has the odor of burning sulphur.
Nitrous—Evolves NO, which forms brown fumes with the air.
Hydrosulphuric—Evolves H_2S, which has a stale-egg odor.
Hydrocyanic—Evolves HCN, which has a bitter almond odor.
Acetic—Evolves $C_2H_4O_2$ with H_2SO_4, and forms a red solution with FeC_3.

Group II

Acids precipitated from neutral solutions by Calcium Acetate:

Arsenious—White, soluble in excess or in acetic acid.
Boric—White, soluble in excess or in acetic acid.
Carbonic—White, soluble in acetic acid with effervescence.
Hydrocyanic—White, soluble in excess or in acetic acid.
Phosphoric—White, soluble in acetic acid.
Tartaric—White, soluble in acetic acid.
Hydrofluoric—White, insoluble in acetic acid.
Oxalic—White, insoluble in acetic acid.
Silicic—White, insoluble in acetic acid, and in all dilute acids.

Group III

Acids precipitated by Barium Acetate:

Chromic—Yellow, soluble in warm HCl.
Sulphuric—White, insoluble in HCl or HNO_3.

Group IV

Acids precipitated by Silver Acetate in the presence of acetic acid or by Silver Nitrate in the presence of nitric acid:

Hydroferrocyanic—White, soluble in KCN; insoluble in NH_4OH.
Sulphocyanic—White, curdy, soluble in NH_4OH.

Hydroferricyanic—Orange-red, soluble in NH_4OH and in KCN.
Hydrocyanic—White, soluble in KCN and in NH_4OH.
Hydroiodic—Light yellow, slightly soluble in NH_4OH, easily in KCN.
Hydrobromic—Yellowish-white, difficulty soluble in NH_4OH.
Hydrochloric—White, curdy, easily soluble in NH_4OH.
Hydrosulphuric—Black, soluble in hot dilute HNO_3.

Group V

Acids not precipitated in the preceding groups:

Arsenious gives yellow As_2S_3 with H_2S in presence of HCl or $H\text{-}C_2H_3O_2$.
Chloric gives a deep blue color with aniline sulphate and H_2SO_4.
Nitric gives the "brown ring" test.

ANALYSIS OF THE ACIDS IN SOLUTION

Use one-third of the solution for the detection of the acids of Group I, and the main portion for the detection of the acids of the other groups.

Group I.

This group includes the CO_2, SO_2, NO, S, $C_2H_3O_2$ and CN ions which are liberated by such dilute acids as HC or HNO_3.

1. CO_2. To a portion of the solution add a few drops of HCl. Effervesence and the evolution of a gas which clouds a drop of lime water shows the presence of carbonic acid.
2. SO_2. To a second portion add HCl and warm. The evolution of a gas having the odor of burning sulphur shows the presence of sulphurous acid. Thiosulphuric acid gives a white or yellow precipitate of sulphur in addition to evolving SO_2.
3. NO. Acidify a third part with acetic acid or dilute H_2SO_4 and add some $FeSO_4$. A yellow-brown or black-brown coloration shows the presence of nitrous acid.
4. S. Acidify another portion with HC and warm. If a gas is liberated which has a stale-egg odor or which blackens a strip of "lead acetate paper," H_2S is present.
5. $C_2H_3O_2$. To a fifth portion add a little alcohol, a few drops of conc. H_2SO_4, and gently warm. The formation of ethyl acetate which has a characteristic odor, shows the presence of acetic acid. Apply this test in the absence of chlorates, chromates, cyanides and iodides.
6. CN. See group IV. A. (4).

Group II.

This group contains the acids which are precipitated from neutral solutions by Calcium Acetate.

A. Boric, Phosphoric, Carbonic, Hydrocyanic and Tartaric acids which are soluble in acetic acid.

B. Hydrofluoric, Oxalic and Silicic acids which are insoluble in acetic acid.

To the major portion of the solution add conc. aqueous calcium acetate Ca $(C_2H_3O_2)_2$ in very slight excess. A white precipitate shows the presence of one or more members of this group. Filter, wash the precipitate twice with cold water and reserve the filtrate and washings for treatment under the next group.

Treat the precipitate on the filter with acetic acid passing the acid solution through the filter as long as any of the precipitate dissolves. Wash any insoluble residue twice with cold water and treat the filtrate under A and the residue under B.

A.

Divide A into four portions. Note that CN and CO_2 are both precipitated by calcium acetate, but the former is more or less soluble in water and both are decomposed by acetic acid, causing effervesence in the case of a carbonate, and giving the odor of bitter almonds with a cyanide (poison).

1. BO_2. Evaporate one portion to about one-half its volume and acidify it with normal HCl. Saturate a strip of turmeric paper with this solution and dry it at a gentle heat. If the strip assumes a pale rose-red color which in turn becomes greenish-black on adding a drop of KOH, boric acid is present.
2. PO_4. To a second portion add an excess of an ammonium molybdate solution, warm and let stand. A yellow crystalline precipitate shows the presence of phosphoric acid. Arsenic acid gives a similar precipitate.
3. $C_4H_4O_6$. Evaporate a third portion to dryness, add a drop or so of conc. H_2 SO_4, and again heat. If the residue blackens and yields an odor of "burnt sugar," tartaric acid is present.

Since boric acid redissolves somewhat after being precipitated by calcium acetate, it will be necessary to test for it again under group five.

B.

1. F. Test a portion of the residue which was insoluble in acetic acid as follows: Cover a piece of window glass or a small watch glass with a thin coating of wax and when the wax is cold remove a portion of it with some sharp instrument. Mix the residue to be tested with enough conc. H_2SO_4 to make a paste and cover the exposed parts of the glass with the mixture. Let the test stand for fifteen minutes, then clean the glass and see if it has been etched where exposed. If so, hydrofluoric acid is present.
2. C_2O_4. Place another portion of the residue in a test-tube with a little MnO_2 and cover it with H_2SO_4. While boiling hold in the escaping vapor a drop of clear lime water on the end of a glass rod. If the drop becomes cloudy due to the liberation of CO_2, oxalic acid is present.

3. SiO_3. Treat a third portion with HCl and evaporate to dryness. Digest the residue with H_2O and HCl and filter. A white gritty insoluble powder indicates silicic acid as SiO_2.

Group III

This group contains Chromic and Sulphuric acids which are precipitated from the filtrate of group two by Barium Acetate.

To filtrate from Group II, add a slight excess of barium acetate, $Ba(C_2H_3O_2)_2$ and agitate. A fine white precipitate shows the presence of sulphuric acid and in that case, filter and pass to the next group. A fine yellow precipitate indicates chromic acid. If a precipitate forms, filter, wash twice and reserve the filtrate for treatment under Group IV.

1. CrO_4. Transfer the precipitate to a test-tube and warm with dilute HCl. Any chromate present will dissolve to a yellow solution, the white sulphate when present remaining undissolved. Filter, wash and confirm the presence of chromic acid by acidifying with acetic acid and adding lead acetate for yellow lead chromate.
2. SO_4. Any white residue insoluble in dilute HCl or HNO_3, confirms the presence of sulphuric acid.

Group IV

This group contains Hydroferrocyanic, Sulphocyanic, Hydroferricyanic, Hydrocyanic acids classified under portion "A," and Hydroiodic, Hydrobromic, Hydrochloric acids, classified under portion "B," which are precipitated by Silver Acetate from acetic acid solutions or by Silver Nitrate from nitric acid solutions.

Strongly acidify the filtrate from the last group with acetic acid, add silver acetate in slight excess and gently warm not boil. Filter, wash twice and reserve the filtrate for later treatment. Divide the precipitate into two portions A and B.

Portion A

Agitate A with a mixture of one part of dilute HCl and three parts of a solution of sodium chloride (1-10) which dissolves the cyanides. Filter and reject the precipitate. Divide the filtrate into three parts.

1. $Fe(CN)_6''''$. To one portion add $FeCl_3$, as long as a precipitate forms. A dark blue precipitate shows the presence of hydroferrocyanic acid. Filter.
2. CNS. If the filtrate from (1) has a blood-red color, which is destroyed by $HgCl_2$, sulphocyanic acid is present.
3. $Fe(CN)_6'''$. To a second portion add a crystal of $FeSO_4$, or a freshly prepared solution of $FeSO_4$. A dark blue precipitate shows the presence of hydroferricyanic acid. Or the filtrate from (1) may be boiled with H_2SO_3 and more $FeCl_3$ added. A dark blue precipitate shows the presence of the acid.

4. CN. To a third portion add a little picric acid, and an excess of NH_4OH and warm. If on standing a light or dark mahogany color appears, hydrocyanic acid is present.

Portion B

Place portion "B" of the precipitate in an evaporating dish with a few pieces of zinc, cover with water, add a few drops of H_2SO_4 and gently warm. When the reduction of the silver salts is complete, indicated by a black precipitate, filter and reject the precipitate. Neutralize the filtrate with Na_2CO_3, filter, reserve the filtrate and reject the precipitate.

1. I and Br. Test a portion of the filtrate as follows: Add to the test an equal volume of CS_2, and then nitro-sulphuric acid (1:1) drop by drop, vigorously agitating after the addition of each drop and noting the color of the CS_2. If the latter becomes pink or violet, HI is present; if yellow, yellow-brown or red-brown, HBr is present. The iodine is first liberated and the colored sulphide may be removed by filtering. To the filtrate add more CS_2 and repeat the operation. When all the I has been removed and liberated Br will in turn color the CS_2.
2. Acidify a second portion of the solution with HNO_3 and add $AgNO_3$ in slight excess. Filter, wash, reject the filtrate and boil the precipitate with an excess of "sesqui" ammonium carbonate. Decant the clear liquid, add a fresh portion of the carbonate and again boil. Decant as before and to the decanted liquids add enough HNO_3 to acidify. The formation of a white curdy precipitate shows the presence of hydrochloric acid. (Hager's Test.)

In the absence of HI and HBr, add to the test solution $AgNO_3$. A white curdy precipitate which is insoluble in HNO_3 and which readily dissolves in NH_4OH, shows the presence of HCl.

Note 1. When $AgNO_3$ is used as the group reagent, the procedure is unchanged except that HNO_3 must be detected in Group I. Interfering acids are nitrous, chloric, ferro and ferricyanic, sulphocyanic and the halogen acids.

Group V

This group contains Arsenious, Chloric and Nitric acids which are not precipitated in the preceding groups, being soluble.

1. ClO_3. To a minor portion of the filtrate from the last group, add a piece of zinc, a few drops of HNO_3 and gently warm. A white curdy precipitate of AgCl shows the presence of chloric acid. Or to a portion of the filtrate add a little formalin, a few drops of HNO_3 and heat, a white curdy precipitate shows the presence of $HClO_3$. In both these tests there must be present an excess of the silver salt.

Remove the silver from the main portion of the filtrate from Group IV by adding a solution of NaCl as long as a precipitate forms. Filter, wash, reject the precipitate and test the filtrate as follows:

2. AsO_3. Acidify the filtrate with acetic acid and saturate it with H_2S. If a yellow precipitate forms at once, arsenious acid is present. Filter, wash, and treat the filtrate under 3. (Omit test if arsenic was found in the analysis of the metals).
3. Concentrate the filtrate to a convenient volume, and in case chloric acid is absent, apply the "brown ring" test directly. Add an equal volume of conc. H_2SO_4 to the test, so that the two liquids will not mix, cool and pour down the side of the tube some $FeSO_4$ solution. Let the test stand for some minutes undisturbed. The formation of a brown or dark brown ring at the juncture of the acid and the test solution, shows the presence of nitric acid. Nitrous acid gives the "ring" with acetic acid in place of H_2SO_4.
4. To detect HNO_3 in the presence of $HClO_3$, acidify the concentrated filtrate, or a portion of it from 3 with acetic acid, boil for a minute with an excess of H_2SO_3. Filter if necessary, reject any precipitate and to a portion of the clear liquid add a drop or two of diphenylamine in conc. H_2SO_4. If a blue color appears at once, HNO_3 is present. This color slowly disappears.

   This test depends upon the action of the sulphurous acid in changing any chlorate present into a chloride. To determine whether all the chlorate has been changed, add to the remaining portion of the solution a drop or two of anilin, and then a few drops of conc. H_2SO_4. A blue color appears at once if any chlorate is present in which case use more of the H_2SO_3. The appearance of a blue color with this test serves to detect a chlorate in the presence of a nitrate. The anilin test gives with a nitrate a yellow-brown color.
5. BO_2. To another portion of the filtrate apply the test for boric acid given under Group II. A. (1).

AN EXPERIMENT IN THERMAL CONDUCTIVITY

PROFESSOR H. L. CURTIS, MICHIGAN AGRICULTURAL COLLEGE

The thermal conductivity K of a body is defined from the equation $H = KA\,\frac{\theta-}{d}\,T$, where H is the quantity of heat in calories which will pass in time T between the two faces of a wall of area A, of thickness d, and whose faces are at a temperature θ and θ'. It would seem that the most simple method of measuring conductivity is to proceed directly

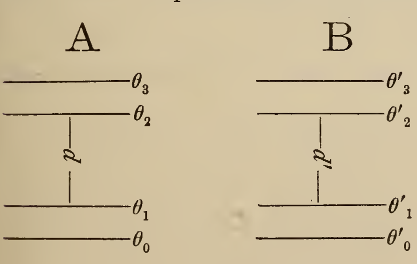
from the defination and measure the heat flowing through a given wall. I was aware that attempts had been made to keep one side of a wall at the temperature of melting ice, and the other at the temperature of boiling waer by passing steam against it, and that these attempts were unsuccessful, because a coating due to the condensation of the steam would form over the surface which would keep its temperature considerably below that of the steam. However, I reasoned that if I used hot water in the place of the steam and measured the rate of cooling of the water I would have overcome the difficulty.

Accordingly I secured two vessels, one of copper and the other of aluminum, whose conductivities I wished to determine. I filled a large pail with crushed ice and water and arranged to stir it thoroughly. I filled the aluminum vessel with a known amount of warm water and suspended it so that the bottom just touched the ice-cold water. I then read the temperature every 30 seconds while keeping the water well stirred. I then attempted to determine the conductivity as follows:

In a short interval of time, say 30 seconds, the change in temperature of the upper face will be from θ' to θ''. The quantity of heat conducted across will be M $(\theta' - \theta'')$ where M is the mass of the water. The temperature of the upper face may be taken as the mean of the two. Substituting in the formula for conductivity M $(\theta' - \theta'') = K\,A\,\frac{\theta' + \theta''}{2d}\,T$, since $\theta_0 = 0°C$. A somewhat simpler formula can be obtained by integrating the differential equation which expresses the conductivity, but that solution would be out of place here.

The results obtained by this method were very much too small. As the only error of great magnitude must be in the temperatures of the two faces, I determined to examine into this. For that purpose I had made two vessels identical, except that the bottom of one was of a different thickness from the other. My experiments had caused me to conclude that there is a surface film of water through which the heat must be conducted, the film not being disturbed by the stirring. If this is the case, the following considerations will hold:

Let A and B be sections through the two plates of which the bottoms of the vessels are made. In these d and d′ represent the thickness of the two metals, above and below which are the films of water. Let the temperatures of the different surfaces be as represented.



When the temperature gradient in the metals of A is the same as that in B., i. e., when $\frac{\theta_2 - \theta_1}{d} = \frac{\theta_2' - \theta_1'}{d'}$ the same quantity of heat will flow in a unit of time through unit cross-section of the two plates provided the thickness of the films on the two plates is the same, and they have the same conductivity. We will then measure the flow of heat

through the two plates and determine temperatures above the upper films when this flow is the same in A and B. Then since the temperature gradient over the upper films will be the same, the temperature gradient in the metal is $\frac{\theta_3'-\theta_3}{d'-d}$. This can be substituted for $\frac{\theta-\theta'}{d}$ in the formula for conductivity, and the remainder of the solution will be as indicated before.

It should be noticed that anything that will effect the nature of the film will materially effect the result. I have found that when a second pail of ice water is used, all other things remaining the same, the rate at which the cooling proceeds is quite noticeably effected. I have taken several readings upon brass, and have the following results which are the most consistent I have been able to obtain:

Accepted values	0.20—0.25
Values obtained	1st 0.14
	2nd 0.11

From lack of time I have not been able to give this a fair test. I wish to try the experiment using distilled water and carefully cleaned surfaces.

I have assumed that the thickness of the film and its conductivity do not change with temperature. This needs careful examination.

SOME USES OF THE ALTERNATING CURRENT IN HIGH SCHOOL WORK

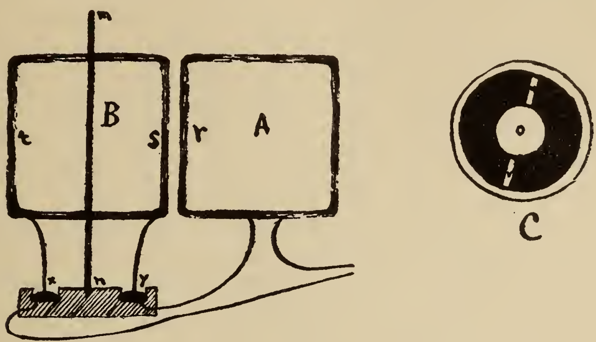
L. M. PARROTT, SAGINAW

I believe the alternating current may be made of almost universal application in outlining fundamental principles, and as an auxiliary apparatus it is almost indispensable.

In my own work the subject of electricity is opened by attempting to get before the pupil a clear conception of the terms used, and the definite meaning of each of these terms. This naturally leads into the subject of the fundamental properties of the current, and this point, to my mind, is the basic principle upon which the entire superstructure is founded. A clear conception of these fundamental properties is therefore absolutely essential, and must be made clear and definite by actual existing evidence.

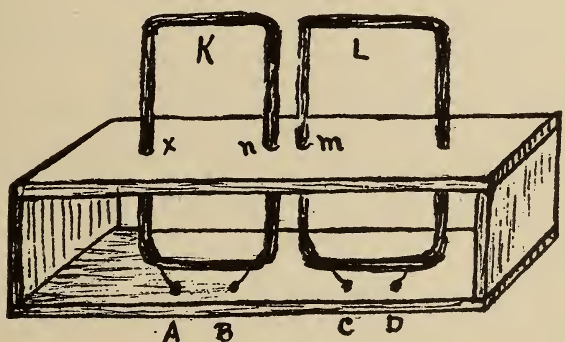
I believe we will all agree that the greatest and most important, if not *the* fundamental property is manifested by what is called, for lack of a better term, the field of force; and until the actual relation between the current and its accompanying lines of force is made unquestionably evident to the pupil's mind, all that the subject can

give him will be but a hazy and imperfect idea. Experiment only can settle the question, and for this purpose a small current is not satisfactory. We are reduced, therefore, in the great majority of schools at least, to the problem of either using a large number of cells, to be made by the teacher at this time, or else making use of the city's incandescent plant, which supplies an alternating current. The latter



is cheap, always ready, easily manipulated, and will show many of the essential relations as completely as a direct current.

To illustrate: If we connect the terminals of the alternating current, through a suitable rheostat, to the posts A and B (Fig. 1) respectively, so that it serges back and forth through the coil K, and sprinkle iron filings around the point x, the circular lines of force will be evi-



dent, thus showing the existence of a field of stress of some nature encircling the current carrying wire. These lines of stress, however, may be more than mere circles of force, and are possibly endowed with some kind of a direction property as well, or possess what might be termed a head and tail with the heads all turned one way with reference to the direction of the current. This question may also be clearly demonstrated by means of our alternating current.

Assume, if you will, that this stress about the wire, or so-called field of force, *is* endowed with a direction property; then, if we assume a particular direction in which the lines are all headed with reference to the direction of the current, and now arrange two parallel wires with current flowing in opposite directions, by connecting the terminals at *A* and *D*, and an extra wire from *B* to *C*, so that the current flows through both coils represented in Fig. 1, the combined field would necessarily be a thick and highly strained field between the two wires. Now, still supposing this same direction property, if we exchange the terminals *A* and *B*, thus reversing the current in one of the coils, we will have it passing through the two central wires, parallel, and in the same direction. Under this condition a line of force circling around the wire *m* would, when attempting to exert its force, or as some would say, when attempting to pass, between the wires, come under the influence of the current in wire *n,* and thus be prevented from exerting itself in the space between the wires, and, affected by this influence, must continue on around the wire *n,* and so encircle both wires, presenting one entire circular or oval field.

Connecting up respectively in the two ways indicated, we see the fields are so arranged. This effect must therefore be due to the cause indicated, and we are inevitably compelled to accept the fact that all lines of force do possess a direction property of some nature. That is, when the current goes one direction, the lines of force also have a direction property, dependent on the current direction. Assuming a head and tail for each line, we mean the heads are all turned one direction around the wire. Which direction we call head, or which tail depends only on convention, and convention has established that the arrow head in the figure is to be called head, or, as ofttimes falsely stated, the line passes around the wire in the direction indicated, the dot meaning current coming up out of the paper.

Some additional facts may be deduced from the two fields described.

Turning our attention to these fields and remembering that these lines are a stress or strain around the current carrying wire, and should therefore act like stretched elastic bands, we note certain actions likely to result. In the first mentioned field these lines are crowded and need more room. Therefore, by their very nature, they should press these wires apart. On the other hand, the situation as exemplified in the second field should be such as to cause the wires to be drawn together.

These facts may be illustrated by means of two coils set up as indicated, the alternating current being fully as effective in proving these well known laws as a direct one.

This simple apparatus may be briefly described as follows: *A* and *B* are two coils connected in series, *A* stationary, and *B* supported by a central axis mn upon which it may freely turn, its ends dipping into the respective grooves which are filled with mercury. These grooves are illustrated

by view *C,* and are so arranged that when the coils are parallel with each other, current is flowing in opposite directions at s and r respectively. *B* is rotated because of the repulsion set up by the crowded condition of the lines of force, and *t* is attracted. t would thus stop near r, but just as it reaches that point, the ends *x* and *y* pass over the bridges *u* and *v* (built of paraffine), reversing the current in the coil *B,* thus insuring continual rotation. The terminals *x* and *y* are double ones, each being made up of two terminals in parallel spread apart slightly more than the width of the bridges *u* and *v.* This will shunt the coil *B* for an instant each half revolution doing no harm thereby, and will prevent the self-induction spark caused by breaking the circuit from fusing the terminals. This experiment not only illustrates these fundamental laws, but may, at the same time, give the pupil a starting point from which to work out the motor and its commutator.

One other fact may be shown from the conditions above. When the current passes the same direction in two parallel wires, we have seen that the field of force encircles both the wires, and that iron seems to be an excellent conductor or retainer of this stress. If, therefore, we wind a wire in the form of a solenoid we have an extended condition of the same idea, the combined result of which is that we have lines of force running through the whole coil and returning round the outside. If now a piece of iron were placed near the end of such a group of parallel lines of force, these lines, like stretched elastic bands, in attempting to manifest their own nature, would pull the iron closer, and if not too large, within the coil. This illustrates so-called magnetic attraction, which is nothing more nor less than the lines of force attempting to manifest their own nature. This fact may be illustrated by hanging such a coil by one end, and then holding a large nail near the lower end. It will be lifted out of the hand. A perceptible heating may be felt manifested in the nail which is practically absent when the same experiment is tried with a direct current. This will certainly aid in giving some idea of what takes place within the nail at each alternation of the current, which, as we have previously seen, is accompanied by a reversal in the direction of the lines of force sent through the coil and hence through the nail. The vibrations caused by these reversals will also be plainly perceptible to the hand holding it. Magnetism, to my mind, may be made clearer and more real if it were made to follow and not to precede, as in most texts, the experimental evidence of this fundamental property of a current: its field of force.

By some such simple experiments as these, all with "home made" apparatus, I believe nearly all the fundamental properties of the electric current may be easily demonstrated with the city's incandescent or alternating system. It is cheap and very convenient, and a current of some kind is a practical necessity in every school in order that our

young people may obtain a clear idea of the subject. As an auxiliary aid in the lecture room, I find it almost indispensable.

Take, for example, one illustration, the arc light. I confess I cannot well get along without it. With it we may accurately illustrate the law of inverse squares, focus and conjugate foci of concave mirrors, laws of reflection of mirrors, not to mention the value of the stereopticon. How to use it to adequately show the laws of reflection of mirrors may need a little further explanation.

We have a tank about five feet long and four broad with a glass bottom. I support this at its ends and place the light and a mirror (either a large concave or plane) beneath in such a way as to reflect the light upward. Placing water in the tank to the depth of about one-half inch, and a piece of wood, held down with a weight, cut, say, in the form of a concave mirror; by touching the water with the end of a ruler at some point as, x, representing the position of the object, the waves will proceed to the mirror and be reflected, coming to a point which represents the position of the image. To send parallel rays to the mirror it is only necessary to touch the whole length of the ruler simultaneously. With the electric light below the tank the whole picture is thus magnified and projected upon the ceiling and the whole problem made evident.

ALTERNATING CURRENT APPARATUS AND EXPERIMENTS

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The purpose of this paper is merely to call attention to the apparatus that I have assembled for experiments with the alternating current, illustrating some of its properties and uses. I was fortunate in obtaining two discarded regulating coils from the Western Alternating Current Arc Lamp, old form. The four coils of one of these (a. Fig. 1) I have so connected with binding posts, plugs, and switches that it may be used as a step down transformer, as a step up transformer, or as a transformer without change of voltage. It may also be used as an inductive resistance. Figure 2 is a view of the top of this showing coils, plugs, switches, and connections. The alternating current circuit, 110 volts, is connected to the primary posts, a one hundred ten volt lamp is connected to the secondary posts, both switches are on contact No. 1, coils, 2, 3, and 4 are connected with plugs. This is then a step down transformer and the lamp is very dim. By placing switches A and B on No. 2; and connecting coils 1 and 2; also 3 and 4 by plugs, the lamp gives its usual candle power. If switches A and B are placed on No. 3 and coils 1, 2, and 3 are connected, it becomes a step up transformer and the lamp lights with dazzling brilliancy.

This may be used as an inductive resistance by connecting the alternating circuit to primary post No. 1 and secondary No. 1 and connecting by plugs coils 2, 3 and 4 with switches A and B both on 1. By changing switch A to 2, one coil is cut out, changing to 3, two coils are out, changing to 4, three coils are out. All four coils may be cut out by placing both switches on contact No. 1 and connecting coils 1 and 2.

The four parts of the other coil (b. Fig. 1) are so connected as to make it the stator of a small induction motor. The two opposite coils are so connected that they will produce like poles in the same

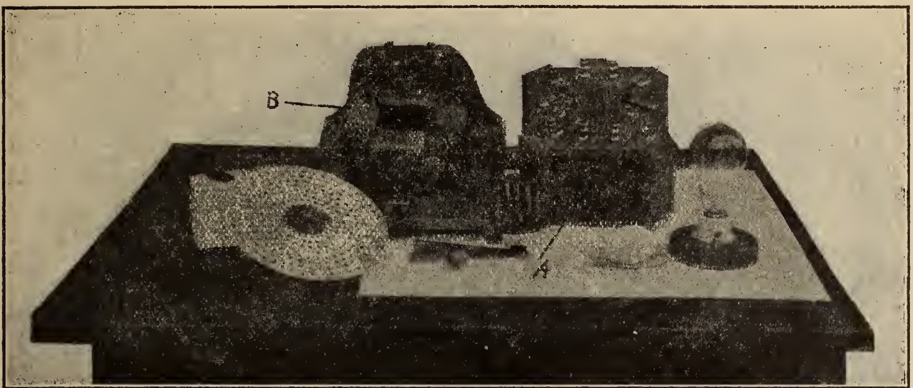


Fig. 1

direction at the same time; that is, they oppose each other. These are connected to the alternating circuit through a non-inductive resistance. The other two coils are joined in like manner and connected with the same circuit through the inductive resistance above described. These connections are shown in Fig. 3. This inductive resistance will produce such a lag of the current in that circuit as will make the magnetic field a rotating one. This rotating field may be shown by placing within the coil, the block with a small iron bar supported on top, shown in Fig. 1. The bar is pulled around by the rapidly rotating field. When its rate becomes the same as the field, either circuit may be disconnected and the bar will continue to rotate in synchronism with the field.

An alumnium siren supported on a pivot just above the coil may be made to rotate at any desired speed by varying the current; it will rotate much more rapidly if a piece of sheet iron is held just above the siren.

By removing the block, the small squirrel cage armature shown in Fig. 1 may be placed within the coil. It will rotate rapidly, illustrating the principle of the induction motor. If a four-inch watch glass be

placed on top of the coil and any kind of metal ball be placed on this glass it will rotate.

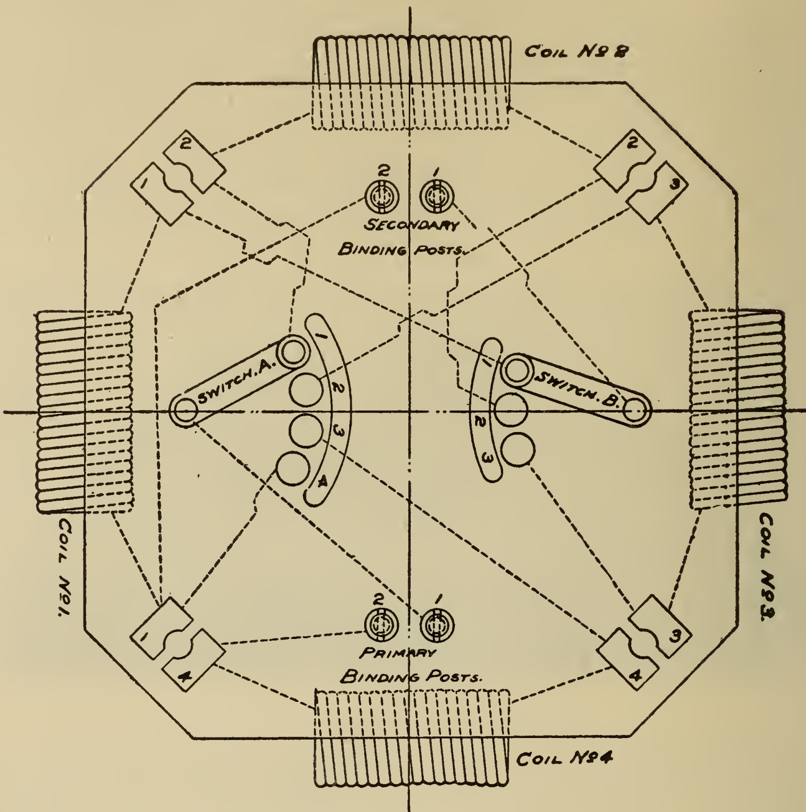


Fig. 2

By filling the shell of a hen's egg with iron filings and placing it on this glass, an amusing experiment may be given. At first it begins

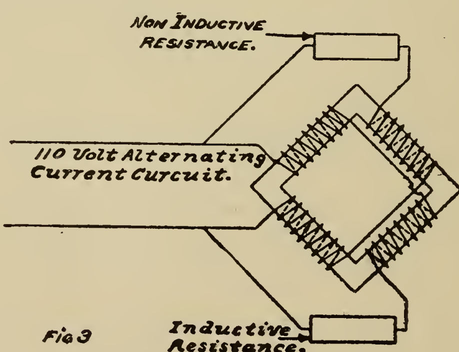


Fig 3

to rotate on its side or on its shorter axis, but after attaining a certain

velocity it will stand up and rotate on the end. It is perhaps unnecessary to say that the same experiments may be performed by using in place of the inductive resistance the same apparatus as a step down transformer.

NOTE.—The Scientific American of May 6, 1906, has a valuable article on this subject.

THE ENTRANCE REQUIREMENT IN PHYSICS AND ITS RELATION TO THE PHYSICS OF THE COLLEGE COURSE

PROFESSOR N. F. SMITH, OLIVET COLLEGE

A conference such as this, composed of representatives from the university, the colleges and the secondary schools, seems to be a peculiarly appropriate place to discuss a question directly affecting our mutual relations. I know that the subject of the college entrance requirement in physics is an old one, but educational conditions in schools and colleges are changing so rapidly as to warrant the reconsideration of some aspects of this theme. My subject seems naturally divided into three parts, which I wish to consider in order.

1. Should physics be a required subject for admission?

I think the time has come when all of us are ready to admit that those subjects form the best basis for entrance to college which give the best preparation to the students whose education is finished with the high school course. My question might therefore be put in the form: "Should physics be a required subject in the high school course?" In this day when the elective system has been allowed to run riot through our courses of study there is a tendency to make practically all subjects optional, both in school and college. Whatever may be said in favor of such a system in the college or university,—and I believe myself that it is very little,—these arguments certainly do not apply to the high school where the pupils are far too immature to make a choice of subjects on any rational basis. Some subjects then should be prescribed as required of all students in the high school course. Among these should be a certain amount of science work, and among the sciences, it seems to me there are strong reasons for selecting physics.

These reasons are chiefly as follows: (a) Physics is a dicsiplinary study comparable to mathematics or Latin, and possesses this characteristic perhaps to a greater degree than any of the other sciences of the high school course. (b) The principles of physics are fundamental, underlying the other sciences and forming a proper basis for their study. (c) A knowledge of the elements of physics is essential to any

intelligent understanding of the great forces in constant use in everyday life.

From the college point of view, then, it would seem that physics should be a required subject for admission quite as much for the sake of those students who do not go to college as for those who do, since making physics a requirement for college entrance will tend to keep it a requirement in the high school course. In opposition to this view, objections based on local conditions of expediency are sometimes urged. A high school is pointed out which is equipped, either in teaching force or apparatus or both, to do good work in chemistry, but is poorly equipped for work in physics. We are asked whether it is not better for that school to continue its course in chemistry and not undertake the work in physics. My answer is yes, if it cannot do both in a satisfactory manner. But that is not a reason why the general principle should be changed or why the college should change its entrance requirement. A somewhat similar objection is based on the expense involved in providing equipment for proper instruction in physics, which perhaps exceeds that required for the other sciences. I shall refer to this more fully under the next division of my subject, but I wish to say here that the few hundred dollars' expense initially involved is insignificant when any educational principle is at stake, and, secondly, that the great mistake of the small high schools seems to me to be the attempt to include in their curriculum all of the sciences instead of concentrating their energies and their resources upon one or two. Let the small high school with only three or four teachers gave up the attempt to teach zoology, botany, physiology, physics, chemistry, and what not, and perfect a thorough course in one or two of these subjects and the expense will be no more and the educational results far better.

My last reason for urging physics as an entrance requirement is one based on the desirability for uniformity in this matter. Physics is of course *accepted* as an entrance subject by all the colleges. There seems to be a growing tendency to make it a required subject. Especially is this true in our own state where it is required by the University of Michigan, Olivet, Hillsdale, Kalamazoo, Adrian, and Hope. It seems to be optional at Alma and Albion,—the latter specifying in the science requirement, "physics preferred."*

It may well be asked why, if physics is already required by practically all the Michigan colleges, it is necessary to discuss this phase of the subject. I reply, to emphasize the importance to the smaller high schools concentrating their attention upon this one science, not merely because it is a required subject for admission to college, but because it is best for the educational development of their pupils that this one

*Physics is now required for admission to Albion College.

science should be taught well rather than that several sciences should be taught indifferently.

2. If physics is presented as an entrance subject, what should constitute a unit course? Here again I wish to emphasize the fact that the sort of a course which seems desirable as a preparation for college differs in no way from the course which is best for the students who do not go to college. It is true, however, that the requirements of the colleges and particularly of the State University, have had and will always have a tremendous influence in determining the character of the courses offered in the high schools. No fountain rises higher than its source, and the source of the teaching in the high schools is the University and the colleges. The standard of this teaching is largely determined by the minimum entrance requirements of these institutions. If the Michigan colleges have taken the lead in placing physics among the required subjects for admission, they are lamentably behind most other institutions in the character of the course which they require for college entrance. I do not, in this place, need to argue the importance of individual laboratory work on the part of the student as a part of the preparatory course in physics. Most of us would agree that this work should be chiefly quantitative in its nature and that a proper record of the experiments should be kept by the student. Nothing less han this is accepted as meeting the admission requirements by any college or university of the first rank, so far as I know, outside the state of Michigan. Nothing less than this is worthy of the high schools of this state where an attempt is made to present the subject. And yet in studying the catalogues and inquiring into the practice of the colleges of Michigan, I find great uncertainty or great deficiency on this point. This is due in large measure to the position taken by the University of Michigan, the natural educational leader in this state.

I am pleased to note in the announcements of the last two years a distinct advance over the statement in the earlier catalogues of the University. The last announcement in defining the physics requirement says: "The course should include one period of laboratory work per week, throughout the year." This is better than the previous statement: "Laboratory work is earnestly advised but not required," but even the last statement is far too vague. Does the University *require* such work for admission? What does it regard as a satisfactory laboratory course? What means are taken to ascetrain the character of the student's laboratory work? These are questions which should be more explicitly defined.

Albion College admits without examination students from all schools approved by the University of Michigan, thus indorsing their standard. Kalamazoo defines her entrance requirements somewhat vaguely. An idea of what is considered acceptable may be gained by a reference to her own preparatory course. "Physics; Fourth year; fall

and winter terms; many experiments in which the pupils frequently assist are performed before the class." Hope College accepts the standard of the University of Michigan. Adrian gives no specifications. Alma specifies "the equivalent of Carhart & Chutes' text together with an approved laboratory course of not less than forty experiments actually performed at the school by the candidate." Hillsdale's catalogue gives no information on this point, but I learn by direct inquiry that the requirement includes an approved course of *quantitative* experiments and that the student's original note-book must be presented for inspection. The Olivet catalogue specifies, "At least thirty *quantitative* experiments performed by the student, and the note-book presented to the Admission Committee." We see therefore that probably four and possibly five of Michigan's higher institutions do not regard individual quantitative laboratory work as an essential part of the high school physics course; the University is not explicit in its statement although its practice in the past has been not to require such preparation of its students; while three of the colleges maintain such a laboratory requirement.

Turning our attention now to other states, we may refer to the physics requirement as defined by the College Entrance Examination Board, which has been adopted by practically all of the eastern institutions. This requirement is based on the report of the Committee on Physics of the Science Department of the National Educational Association. The candidate's preparation must include individual laboratory work comprising at least thirty-five exercises selected from a list of sixty-one, all but four or five of which are quantitative. The laboratory note-book must be presented for inspection. The definition of the requirement by the North Central Association of Colleges and Secondary Schools,—to which the University of Michigan, Albion and Olivet belong—is identical with that just read. Referring now to a large list of individual catalogues of colleges and universities I have found not a single one outside our own state which contains an intimation that laboratory work is not required. In many catalogues the requirements are not clearly defined but referring to catalogues of the University of Chicago, Northwestern, Illinois, Wisconsin, Kansas, Leland Stanford, Washington, Missouri, Western Reserve, Cornell and Vermont, and such colleges as Bowdoin, Amherst, Beloit, Knox, Washburn, Iowa and many others, the requirement for a definite amount of laboratory work is distinctly stated. Why should the schools, the colleges and the University of Michigan be behind other states in this respect? The University defended its position in the past by saying that the high schools were not yet prepared to do satisfactory laboratory work in physics. I fear that in many cases this is true today even in schools upon the accredited list of the University, but is not the reason largely due to the lack of incentive which the University and the colleges have offered them to do this work?

The objection is often raised that the expenses involved in the equipment of a physical laboratory renders it impossible in the small high school. I am sure that this feeling arises from an ignorance of the facts. I have within the last two years advised with the school boards and superintendents in several small towns concerning the equipment of their schools for laboratory work in physics. I am satisfied with an initial expense of one hundred and fifty dollars properly expended will enable any school in a town of not over fifteen hundred to commence a satisfactory laboratory course, and the additional expenditure of forty or fifty dollars per year for a period of a few years will soon secure an excellent equipment for high school work. And why did these schools ask this advice and make this start? Primarily, of course, because they wished to improve the grade of their work, but in each case the *immediate* cause was a desire to be placed on the accredited list of Olivet College. If one institution can effect this result in a few schools how much would be the improvement of our physics instruction if all the institutions of the state should act together!

It would seem, then, that in accordance with the requirements of the leading colleges and universities of the country, east and west, and in accordance with the methods of presenting the subject generally recognized as best, the time has come when the higher institutions of Michigan should insist on a definite amount of *individual, quantitative* laboratory work as a part of the entrance requirement in physics. To insure the carrying out of this requirement, it seems necessary, for the present at least, to insist that each candidate for admission shall present the record of his laboratory work, duly certified, to the proper college officer. That this would do more than any other single thing to improve the character of the physics teaching in the smaller high schools I think there is no doubt.

3. But little space is left for me to discuss the third division of my subject, viz: the bearing of the physics entrance requirement on the college course in general physics. It goes without saying that students in the same class should have approximately the same preparation for the course. The college course in general physics should be a second year course in the subject in which it may be assumed It may be necessary ta review these briefly but the course should be that the student is familiar with the elementary physical phenomena. devoted chiefly to a discussion of those portions of the subject which are beyond the scope of the high school course, e. g., simple harmonic motion, moment of inertia, the simple and compound pendulum, the kinetic theory of gases, etc. It seems to me quite as important that laboratory work should accompany this study as that it should form a part of the work of the earlier course, but the experiments should be of a distinctly higher grade. It does not seem worth while that the student should repeat experiments which he has carefully performed

before, the only variation being perhaps the use of somewhat better apparatus and the addition of a few corrections as, for example, most of the determinations of density. The experiments should rather be carefully chosen to illustrate the new principles which are being discussed in the lecture room. And yet no satisfactory set of experiments can be made up for the college course unless it can be assumed that the students in it have already performed a set of quantitative experiments illustrative of the more elementary principles of physics. There is not time in the college course to teach these principles, and nothing fixes a principle in the student's mind so well as making it the basis of a quantitative experiment. It is not fair to a large number of students who have adequate preparation in physics to adapt the college course to the needs of those who have not.

Let me repeat in conclusion the three points which I have tried to make: 1st, that physics should be required of all students for admission to college; 2d, that individual quantitative laboratory work should form a part of the work required; 3d, that the college course in general physics should presuppose such a course and should be adapted both in the work of the laboratory and the lecture room to the needs of students who have had such preparation.

THE ENTRANCE REQUIREMENT IN PHYSICS AND ITS RELATION TO THE PHYSICS OF THE COLLEGE COURSE

PROFESSOR C. W. GREENE, ALBION COLLEGE

In the consideration of the subject of "Entrance Requirements" there are, unfortunately, usually two distinct viewpoints. From the first, we ask what requirements shall be made in order to insure the best possible preparation of the high school student who expects to attend college, for the successful pursuance of college work. From the second, we inquire as to what shall be the content of that high school course which shall most enrich the life of the ordinary student, who will never enjoy the privileges derived from a college education. Although possessing in common with the other members of this conference a strong desire to make our first college course in physics effective in the highest degree, I yet maintain that we should consider the subject in hand mainly from the second viewpoint.

However, whether we occupy one viewpoint or the other, it is clearly evident that strong and yet reasonable college entrance requirements have exerted, and will continue to exert, a strong influence on the development of the high school courses of study in Michigan. Such requirements, therefore, benefit alike students who enter college and

those who do not. Whether we be physicists, chemists, biologists, mathematicians, or followers of some other line of scientific work, we shall, I believe, all agree that physics should be a required subject for entrance to college. I shall mention but three of the reasons that might be advanced for making this requirement: (1) At least a high school course in physics is a fundamental prerequisite to the pursuance of any college course in science. (2) In the field of physics the high school student finds an opportunity for interesting and practical applications of his mathematics. (3) Because of the nature of the subject matter, the course in physics develops in the student a keener appreciation for and ability to interpret, many of the ordinary phenomena practically related to every-day life. In cooking, in heating, in lighting, in the working of the machinery of the manufacturing plant, in transportation,—in short, in the controllable and uncontrollable manifestations of nature, the student sees the workings of the laws of physics. This third reason alone is sufficient, I believe, to justify the colleges in making physics an entrance requirement; for the colleges would thereby exert a strong influence toward strengthening the high school courses in physics.

In the determination of what should constitute a unit course in physics, there are two elements that should be taken into consideration, —(1) the time element; (2) the subject matter of the course. As regards the former, it should be required that not less than the equivalent of four recitation periods, of forty-five minutes each, per week, throughout the year, be given to the subject. As regards the subject matter and requirements made of the students, it is my opinion that the high school course in physics should not be an abbreviated course in college physics, nor of its intensive character; but that it should be of a more popular character, a course that along with the intellectual development which it gives the pupil, will also give him a large fund of information regarding physical laws and phenomena.

I would not have you infer that I favor the under emphasis, in any degree whatever, of the real essentials of the course. Unfortunately, it is too often taken for granted that high school students know many facts, perfectly evident to the specialist, which facts the students have never had the opportunity or occasion to learn; it is too often assumed that pupils have powers of analysis and reasoning that teachers have no right to expect of pupils of high school age. The pedagogy of physics would, in my judgment, be a profitable subject for consideration by some one at some future meeting of this conference.

To be specific, what should constitute a unit course in physics for the average high school, insofar as the text-book work is concerned, may be illustrated by the content of such a text as Carhart and Chute's High School Physics under the following conditions: (1) About one-third of the most difficult problems should be replaced by questions

relating to common phenomena, the answers to which illustrate physical principles studied. For instance, would it not be wise to introduce more such questions as, "Why does a person lean forward in climbing a hill?" "How is inertia illustrated in the beating of a carpet, or in the stamping of the snow from the feet?" 'Why does a partially deaf person place his open hand back of his ear when listening to a speaker?"

(2) It is highly desirable that a separate grouping be made of problems that are to be solved by the graphical method, if such problems are to be given at all; and that specific directions as to methods of construction and instruments to be used, precede the first list of problems to be solved graphically.

(3) The insertion of a tabulation of fundamentals at the close of each chapter would materially assist the student in the average high school to organize his knowledge.

(4) For the benefit of the teachers in our medium grade high schools, about forty to fifty of the least essential topics should be designated as optional.

I trust it is evident from what I have said that the suggestions made are meant to be for the benefit of the medium grade high schools, and are not meant to apply to high schools of the class of Ann Arbor, Lansing, Detroit, and similar schools; for the work of teaching physics in these latter schools is in the hands of those who are abundantly able to cope with the problems that arise, without any suggestions on our part. Again, I do not wish to be regarded as an exponent of adverse criticism of the text-book mentioned. That particular text was cited because its content is familiar to all members of this conference, and because it probably meets the needs of the average high school as fully as does any other text on the market.

With regard to the laboratory work, it is desirable that one double period per week be devoted to qualitative and quantitative experiments performed by the students *under the supervision of the instructor.* However, I do not deem it to be practicable at the present time for the colleges to fix a definite amount of quantitative work as a part of the required unit for entrance to college. It is my belief that a little missionary work done by this conference would be productive of greater benefit to the teaching of physics in the high schools of our state. A suggestive list of perhaps eighty to one hundred experiments suitably correlated with the work of the text-book, accompanied by a brief statement of the apparatus necessary for performing each and cost of same, would be a boon to many a teacher of high school physics. In my opinion, it would be very desirable for a committee of this conference to be appointed to investigate to what extent quantitative laboratory work is being done in the high schools of our state, and in what ways this conference can assist in the further strengthening of the

instruction in high school physics; and for such committee to report the results of its work at our next conference.

Although I do not deem it expedient for the colleges to make quantitative laboratory work a part of the entrance requirement at present, I do favor our giving strong encouragement to the development of systematic laboratory work. To that end, a certain number of hours advanced credit should be given to students who have completed a strong laboratory course, under the following conditions: (1) The student should present a systematically kept laboratory book. (2) He should either pass a satisfactory examination upon the content of his note book, or, if he enrolls for a college laboratory course, he should give evidence by the character of his work that he understands the significance of the work for which he asks credit. (3) The number of hours of advanced credit given should vary somewhat according to the character and extent of laboratory work done.

The first college course in laboratory work should be sufficiently flexible so that it will accommodate both those who have had a good course in the high school and those who have not. It is my belief, also, that the first college course in physics should consist of correlated text-book and laboratory work. Closer correlation renders the subject matter of the course more readily understood; it gives the student more of a realizing sense of the significance of the work; and, at the same time, it gives the student a keener interest in and a greater love for the subject of physics.

BOYLE'S LAW APPARATUS

MR. C. D. CARPENTER, MICHIGAN STATE NORMAL COLLEGE

A very good instrument to use in demonstrating Boyle's law is shown in the accompanying cut. It is similar to the J-shaped one in

common use, differing in that the short arm is about 90 cm. long with a glass stop cock at the end, while the long arm is about 150 cm. long, opening at the upper end with a small funnel into which the mercury may be poured, and at the lower end with a stop cock by means of which mercury may be drawn off. Thus by the use of the stop cocks the heights of the mercury columns can be adjusted, and the volume of the gas and the amount of pressure varied at pleasure.

In the use of the instrument, the sum of the barometer reading and the height of the mercury in the long arm minus the height of the mercury in the short arm is always used as the pressure. The length of the short arm (properly calibrater) minus the height of the mercury in it may always be regarded as the volume of the gas. The extra length of the short arm

enables one to use the instrument as a barometer. By starting with about 30 or 40 cm. of gas the pressure may be varied from one-half an atmosphere to nearly two.

In the performance of this experiment the same precautions must be taken as are necessary in the use of other instruments. The mercury must be perfectly pure and dry, the instrument dry and clean, and the gas used must also be dry in order to obtain the best results. A small rubber band looped around the glass tube and over the stop-cock will prohibit accidents of spilling the mercury.

The instrument can be made by most teachers of physics and chemistry and at a very little expense.

AN EXPERIMENT IN UNDER COOLING

C. F. ADAMS, CENTRAL HIGH SCHOOL, DETROIT

The cooling of a liquid below its freezing point without solidification is very easily and beautifully shown by the use of glacial acetic acid. The absolute acid is said to freeze at 17 deg. C., but that containing 99 or 99.5 per cent acid freezes at about 13 deg. C. Fill a large test tube, or, better, a large ignition tube, about half full with the acid and close this tube with a rubber stopper having a thermometer extending through it into the acid. Place this tube in a mixture of ice and water. In this way the acid may be cooled to nearly 0 deg. C. without freezing; but a gentle tap on the inside of the tube with the thermometer starts the freezing and the whole becomes solid with a rapid rise of temperature tothe freezing point. The experiment may be quickly repeated after melting the acid by setting the tube in a beaker of tepid water.

THE NERNST LAMP IN THE LABORATORY AND SIMPLE EXPERIMENTS ON RADIO-ACTIVITY

F. R. GORTON, MICHIGAN STATE NORMAL COLLEGE, YPSILANTI, MICH.

The Nernst lamp consists essentially of a specially prepared filament A, Fig. 1, called the glower, and a series resistance B, called the ballast. The glower possesses the property of conducting electricity only when hot. Joining a glower and a corresponding ballast across the electric lighting mains and heating the filament in a flame brings it into a conducting condition after which the current quickly carries it to a temperature at which it gives off an intense light. The ballast

consists of an iron wire of such a length and size as to offer sufficient resistance while conducting the necessary current. Obviously the glowers and the ballasts must be adapted to the voltage on which they are to operate. These parts of the lamp already described can be had neatly mounted in lamp bodies in which the initial heating of the glower is done automatically by the current. While the complete lamps are excellent for commercial lighting purposes, a more convenient mounting is desirable for use in the laboratory. One form that has been found useful for many purposes is shown in cross-section in Fig. 2. The parts are mounted on part of a porcelain ceiling rosette used

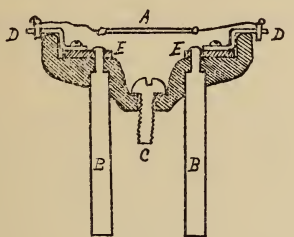


Fig. 2

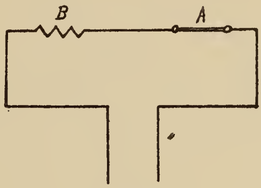


Fig. 1

in electric wiring. BB are two brass posts passing through the screw holes in the porcelain and attaching to the small brass plates EE. The joints cannot be soldered on account of the heat produced while the lamp is in operation. To the plates EE are attached the metal extensions DD. These are drilled near the outer ends to receive the small

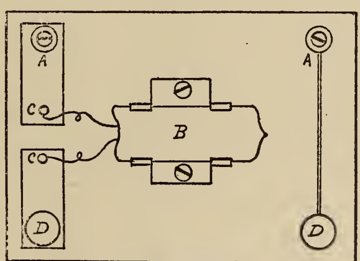


Fig. 3

aluminum pins with which each glower is provided. The large screw C serves to connect the lamp to the kind of holder or stand desired. The metal parts can be protected from the intense heat of the glower by filling the holder with plaster of Paris. The electrical connections are made by attaching flexible lamp cord to the ends of the posts BB. These contacts may be soldered. It is advisable to fit pieces of glass tubing over the posts before attaching the wires to prevent short-circuiting. The ballast may be placed anywhere in the circuit. A convenient mount is shown in Fig. 3.

The lamp as described serves admirably as a luminant for projection purposes for pictures five or six feet in diameter. Smaller pictures in a partially darkened room can be distinctly seen by a class. Two 110-volt glowers serve for projection in a room seating three or four hundred.

Another application can be made in rendering galvanometer deflections visible to a class. Place the lamp about 75 cms. in front of a mirror galvanometer and a convex lens whose principal focal length is 50 cms. about 65 cms. from the lamp and between the two. A brilliant image of the glower will be reflected upon a screen or scale placed behind the lamp at a distance of about two meters. Of course, other lenses than that mentioned may be used and the correct position of all the parts found by trial. The image is bright enough to be observed without darkening the room.

A brilliant point source for experimental purposes can be produced by placing a slit near, and at right angles to, the glower. For work in optics not requiring a very narrow slit, the glower itself serves very well.

Other uses will suggest themselves to teachers of physics as they come to use this luminant. The glowers and ballasts are made both for direct and alternating currents. They can be procured from the Nernst Lamp Co., of Pittsburg, Pa., or Chicago. The nature of the current and the voltage must be stated in ordering the parts.

Two effects of radio-active substances are easily made use of in the laboratory; viz., the photographic action and the electrical effect due to the radiations emitted by such bodies. Probably the most accassible substance possessing the property in any marked degree is to be found in the Welsbach gas mantle. If such a mantle is laid flat against the film of an ordinary sensitive plate and left in the dark for a week or more before being removed, the process of development will bring out a distinct image of the mantle. The experiment can be made by using the mineral Pitchblende, or Uraninite, which is usually found in mineralogical collections and is kept in stock by dealers in such materials. Good results can be obtained by breaking the rock in small pieces and strewing it around upon the plate. If a coin, for example, is first placed on the plate, a clear spot will result on developing due to the shielding action of the metal. The activity of the mantle is due to the presence of Thorium, while that of the pitchblende arises from the Uranium contained in it. A part of the activity of the latter may be due, however, to the presence of a trace of Radium which is found in pitchblende. The photographic effect may be produced by radium-cards and radium-pencils sold by dealers in such apparatus at a small price.

The electric effect, so-called, is the action of a radio-active substance in rendering the air around it a conductor of electricity. Thus a charge placed on an electroscope will readily escape in the presence

of a radio-active substance. In order to detect the influence of a radio-active body on an electroscope, we have only to make the capacity of the instrument small enough to make the loss of charge apparent. While the activity of a gas mantle can be detected, the influence of a piece of pitchblende is greater. In fact, by projecting the leaves of a small gold-leaf electroscope upon a screen, the effect of the mineral can be observed simultaneously by a number of people.

A CONVENIENT AND INEXPENSIVE ADJUSTMENT FOR GALVANOMETER SCALE

MR. W. H. HAWKES, ANN ARBOR, MICH.

This form of galvanometer scale method is presented as a substitute for the telescope form, especially for high school use, its chief merit being the simplicity in the mounting and adjustment of its parts. The facility with which its reading may be taken and the clearness of its indicator. The scale is near to the operator so that the smallest divisions are easily read and without the exertion attendant upon taking observations through a telescope or some small aperture requiring the use of only one eye and certain facial contortions for a successful operation. The scale may be used with any form of reflecting galvanometer having a concave mirror. It is in no way attached to the galvanometer, resting on its own movable and adjustable support.

The galvanometer carries a concave mirror of about 2 cm. diameter and 30 cm. focus; is placed about 60 cm. from the scale. This distance requires the light to be just in front of the scale support or at about twice the focal distance of the mirror.

The scale may be carried on a strip of ground glass of about 40 cm. length and 5 cm. in width, graduated with lead pencil or India ink to any desired scale, or a paper scale may be mounted on the ground glass trimming the lower edge of the strip to the divisions of the scale. This may be cemented to the upper part of the strip of glass on the side facing the operator. When in use the lower half of the circular field of light will travel just below the scale so that the pointer will fall in with the lines on the scale. By moving this portable scale forward or backward a sharp focus is easily obtained and by moving the scale laterally any zero reading may be adjusted.

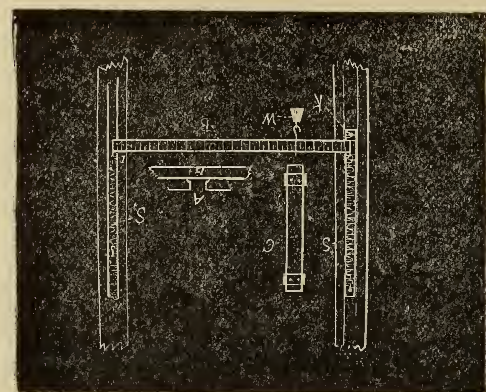
The most accessible and convenient efficient light is the ordinary

Welsbach burner with mantle, fitted to screw into the base of a Bunsen burner. Over the mantle in the place of the ordinary glass chimney a sheet iron chimney somewhat shorter is used. In this, at the proper distance from the bottom, a circular aperture is cut about ½ inch in diameter and across this is soldered a fine wire for indicator. The light with hood then is in no way connected with galvanometer or scale so that in the adjustment of either the galvanometer is not disturbed.

A SIMPLE APPARATUS FOR PARALLEL FORCES

D. F. ROSS, YPSILANTI

This piece of apparatus is designed to overcome an element of error in the experiment of the composition of parallel forces. When the two draw-scales, or coiled springs, used to represent the two forces, are attached to fixed supports there is but a single position for the point of application of their resultant such that the bar will assume a horizontal position; and when the bar assumes an inclined position, the forces are no longer acting parallel with each other, and this inclination is considerable, if the springs are quite sensitive, the nearer this point approaches either of the other forces.



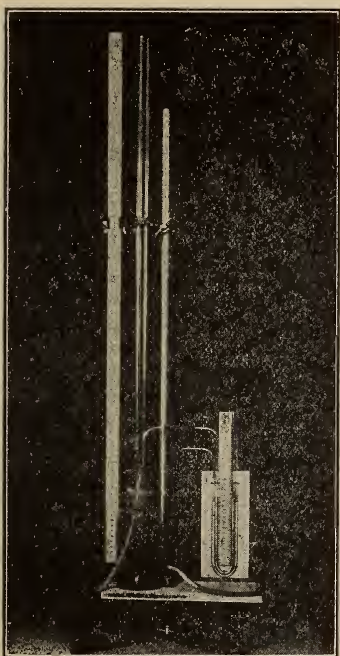
The accompanying figure illustrates a means of overcoming this difficulty, and needs but little explanation to make its action clear. The spring "S" is fastened to a scale which can be raised or lowered as the occasion requires, and held in position by means of the set-screw, "K." "C" is a back view of this sliding scale, showing the two brass plates which project beyond the edges and slide in grooves in the uprights, shown in "A," thus holding it in position and at the same time admitting of a free movement. A scale not shown in the figure, on each upright, enables the student to readily bring the bar into a horizontal position.

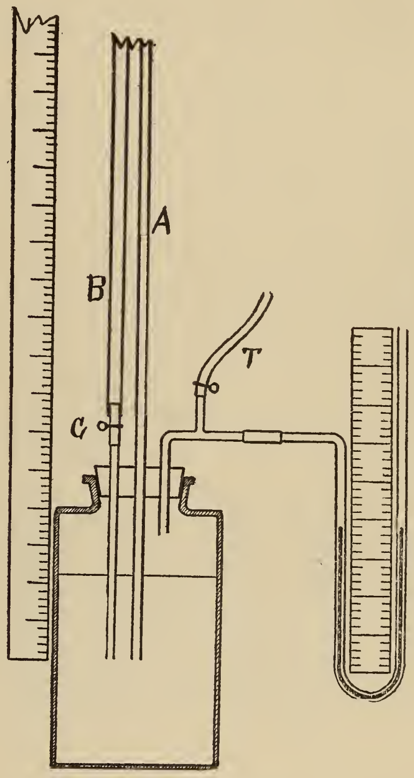
The piece is simple, inexpensive, and gives good results.

APPARATUS FOR DEMONSTRATING LAWS OF LIQUID PRESSURE

H. C. KRENERICK, BERWYN, ILL.

With diagram and print, the apparatus will need but a brief description. The tubes, A and B, are a meter or more in length. Tube B is of two parts, so that the upper part can be replaced by tubes of different diameters. The liquid used is a very dilute solution of potas-





sium permanganate. In the print two manometers are shown; one is the open, and the other, the closed form.

The laws which, I believe, can be satisfactorily demonstrated are: That the pressure is proportional to depth, or water-head; that it is proportional to the density of the liquid; and that it is independent of the shape of the containing vessel. The apparatus serves also to show the use of the open and closed manometers.

To demonstrate the first law, use but one tube, clamping off the other by means of the clamp C. By forcing air into the bottle through

the rubber tube T, the liquid can be raised to any desired height in A. When the clamp in T is closed, the column is held, and the readings can then be taken. By varying the height of the column, a series of readings can be obtained. Knowing the use of the open manometer, the pressures can be obtained, and the relation between depth and pressure determined.

To show the effect of a variation in density, fill the tube B with different solutions, the densities of which have been previously determined. The tube is then connected, and the column lowered to a definite or constant height. The readings of the manometer for the different solutions show the expected relation between pressure and density. Care must be taken to lower the liquid until the entire column is of the solution.

The independence of the pressure from the shape of the vessel is easily shown by replacing the upper part of B with other tubes of different diameters, especially with one in which several bulbs have been blown. It is well to experiment also with the tube inclined to the vertical. I believe the most satisfactory and interesting application of the apparatus is the demonstration of this hydrostatic paradox. Students after studying the text are sometimes inclined to disbelieve the principle in all cases. I usually disconnect the larger tube and have some student, by blowing through the tube T, force the liquid as high as he possibly can in the one tube. When the second and larger tube is also in communication with the bottle, he is very much surprised in finding that the two columns can be raised as easily as the one.

The fact that in most text-books the order of topics is such that manometers and related matter are presented somewhat later than the principles of liquid pressure may cause the application of the manometer to be an objection to the use of the apparatus. If such a piece can be obtained, this objection can be prevented and the apparatus very much simplified by connecting directly to the bottle a small pressure gauge in place of the manometer.

BIOLOGICAL CONFERENCE AND SCIENCE TEACHING

LABORATORY WORK AND ITS RELATION TO FIELD WORK

DR. J. G. NEEDHAM, LAKE FOREST COLLEGE, ILL.

The adjustment of field work and laboratory work in any course in biology should proceed upon the assumption that these are complemental and not antagonistic. Their method does not differ necessarily, but only the conditions under which they are carried on. Either may be static or dynamic according to the purpose for which it is used. Both are necessary for the rounding out of most biological inquiries. Both are means, not ends, and should be used accordingly as they serve the pedagogical purpose of the work in hand.

The laboratory has certain great advantages for any work which may be carried on within it. Some of these arise out of our psychological and physical limitations. The laboratory has a roof and a floor and is usable in all weathers. It has walls which shut out distractions. It has tables and chairs whereon we may dispose our members and our implements; and it has conveniences for assembling around us while we work more apparatus and reagents than would be manageable otherwise. Furthermore, it has means of control of light and heat and other forces, useful in experimentation, which cannot be had outside its walls.

These advantages are so great that we take our work into the laboratory whenever possible. There are, however, certain phases of ecology,—distribution studies, and all studies of life in relation to environment *in extenso,* that may not be done within the laboratory, just as there are studies, like histology, which can make no progress apart from laboratory equipment. However, most biological, even most, ecological studies are furthered by the concurrent and complemental use of both field and laboratory; for each with inevitably raise questions best answered by the other.

Life in action is studied in the field; mechanisms and adjustments are worked out in the laboratory. In general, the field gives us our broad conceptions, the laboratory our nearer and clearer views.

LABORATORY WORK IN BIOLOGY—ITS NATURE, CONDUCT AND VALUE*

LOUIS MURBACH, CENTRAL HIGH SCHOOL, DETROIT.

Biology was introduced into high schools mostly at the instance of colleges when it was established in the higher institutions. First it was allowed, then required for college entrance and was naturally

shaped after college work. Recently it is being held that biology should be taught in secondary schools in such a way as to be a part of their scheme of giving a more liberal education—to better realize his position in nature—to the youth who cannot hope to go to college.

There is probably as much difference in the nature of laboratory work in biology as there are teachers teaching it, although at first thought there might not seem to be much difference so long as it is laboratory work. Being directed to find certain things in a specimen, and how they "look," and what is their significance is one kind of laboratory work. It is still current in colleges and does less harm there than in the high school. It is a great way in advance of the older text-book method. The pupil becomes a verifier; if he ever attains to more he may thank some innate genius or change of environment.

To begin with, then, specimens are to be placed in the hands of all pupils. Mere observations and descriptions of specimens is not a very enlivening work, but may be made more so by the introduction of experiments that bear on the nature of the specimens studied. It is assumed that both the observational work and experiments will be followed by reading and discussion. Study many specimens, at least in the way of comparison, but require only one or two to be drawn and described. So in experiments, there should be as many as can be done, though only the principal one need be written out. Drawing the apparatus used in experiments is time put in that might be better employed. Nearly half the course should be laboratory work, strictly considered. This would leave the other half to be divided between ecological, or field work, and book work, including the discussion or recitation.

Nearly half the time of any study, especially in the lower grade of the high school, should be for the training of the observation, manual dexterity, and the judgment. To further this end the work should be carefully graded and carefully worded. Only those things that are beyond the pupil's comprehension should be told him and then in such way that he will understand that it is not his own idea; and, what is of no less importance, he should be early taught how to express or to show in his record, what is his own observation or inference and what he has from the book or from his teacher.

The laboratory books that give ready made observations and conclusions for secondary schools are still numerous. This alone would be sufficient reason for every teacher making his own laboratory book. * * * Most of the biological work laid out for second year high school pupils should be simpler. * * * The ideal way would be to have so few students that we might give each student such individual attention. With our large numbers we are compelled to adopt more formal methods, and our pupils are reduced to one level which, I fear, is much below what the best in the class could do. Even if we have such simple and explicit directions that the majority can work

alone somewhat independently, the quality and quantity of work will be below the standard of the better members of the class. We reduce to a common level rather than educate.

We cannot give a pupil all the information that he will need in the future. It would seem better to train him to get information for himself after he has left our sphere. This training will incidentally be half information. Furthermore, mere observation work is not going to do this. After comparisons are made, inferences should be required. And wherever this is susceptible of proof, experiments should be introduced.

All through, both the observations and the experiments must be graded. This does not mean as the science work is arranged in grammar schools, but both observations and experiments must be led up to, or the mind of the pupil prepared for the work. This need not necessarily be done in the book or guide, but may be the part of a good teacher.

"The way" is of more importance than the subjects or the amount of work done. Every observation that is carefully made will assure the observer after each comparison, and lead to more certain knowledge. It gives encouragement to continue along the same line, and engenders confidence in the pupil's ability to try other things. He gains mental traits that cannot be replaced by any amount of mere information not his own. He has had the contact that gives faith founded on experience. Besides furnishing a way of acquiring new facts, it furnishes a way of testing information that seems to be open to question.

MATHEMATICAL CONFERENCE

MATHEMATICS IN AND BELOW THE HIGH SCHOOL

MR. L. D. WINES, ANN ARBOR

I fully realize that I have taken a subject that needs a volume for space and months of time for preparation; but it is with no such broad outlook that your attention is asked at this time. During the past few years much has been said and written about just what should and what should not be taught in Arithmetic, Algebra and Geometry, in our public schools, and much advice has been given as to how these subjects should be taught, and when and where to place the emphasis on each. And yet, from what one hears and one reads, results are still unsatisfactory. The high school teacher is far from satisfied with the results obtained in the grades, and the college professor and business man are far from expressing satisfaction with the greenness and ignor-

ance furnished by the high schools. That the world is far from expressing entire satisfaction with the college graduate is evident enough from the general flood of facetious editorials spread broadcast as often as the month of June appears on the calendar. This last matter is of little consequence just now. For if the college professor and the man in business once come to the point where they are satisfied with the high school product, there will be little cause to find fault with the college graduate.

When the world, including teachers and pupils, takes the same interest and makes as fine discriminations in intellectual training, oratorical and debating contests, prize essays, public discussions and examinations, scientific and literary societies and their researches and results, as it does just now in athletics in general, and I might say in football in particular, then will come the day when little or no fault will be found with the results of either our schools or our colleges. Then also will the day have arrived when no dollar spent for schools and education will be begrudged, and no expense be spared for any legitimate educational project; not even, let us hope, for adequate salaries for the people who are doing the severest and most important work in the world. Perhaps at that time a teacher as well as a washerwoman will be able to ride in an automobile.

A high school graduate is supposed to have spent twelve years in school, during eight of which, in the grades below the high school, he is expected to have mastered about fifty different subjects in arithmetic, extending from notation and numeration through stocks and bonds (things he will probably never see as long as he lives) to a final wind-up with a series of a hundred or more problems, most of which are of such difficulty as to easily frustrate the efforts of not only a college professor, but also of the most astute business man. Of course these eighth graders cannot do what is expected of them; and so in the high school they are asked to go over the whole ground once more, in hopes that finally they will know how to perform the four fundamental operations readily and accurately enough to use them in simple business transactions.

Our committees of ten and various other numbers told us a number of years ago to shorten and enrich the course, and our authors tried to do it, and if there are any differences in results, few have been able to observe them. So again we ask the question, what is the reason the grammar school and high school graduate is not up to what we think should be the proper standard? In fact, what is the proper standard, is perhaps the first question we should answer in order that we may place the fault where it properly belongs. What should a high school graduate know, and what should he be, at least mathematically, when in his seventeenth year, he is presented with the coveted passport to life in the world, or the university, or the college? I trust that because little or nothing is here said about what he should be in general, that

it is not taken for granted that I am not a believer in anything else than mathematics and mathematical training. I believe in "culture" and "education" in their broadest sense; by culture meaning a lively appreciation of all that is "fine in life," in "art, music, literature, courtesy, friendship, and religion," I believe in Spencer's thorough preparation for "complete living," mentally, morally, and physically. Or as Professor Nathaniel Butler says, in the education which makes "training for social efficiency" the goal of a high school course. That the high school graduate should possess above all other attainments a first class knowledge of his mother tongue and an intimate familiarity with both English and American literatures all will admit.

Now, what should this product of the high school know in mathematics? And if he does not know it, whose fault is it?

In Arithmetic he should know that the notation that he uses has a scale of ten, and how to perform accurately and readily the four fundamental operations including integral, fractional, and decimal fractional numbers. This ability should include a thorough knowledge of not only the multiplication table, but also of the addition table; an accomplishment which I have found to be very rare. It does seem as though college boys and girls should be able to add numbers without the aid of the fingers, or without stopping to reason out the value of the sum of two integral numbers each less than ten. This is not all that he should know about these elementary affairs, he should know *thoroughly, very, very thoroughly* all the principles of these four rules, for both integers and fractions. He should know that there is what is called a complex fraction and the most expeditious way to simplify it. I was once told by a university professor that his brightest student in calculus quailed every time he met a complex fraction; and I could easily believe him from my own experience in teaching trigonometry.

This graduate should have a good knowledge of factors and divisors and multiples, of tests of divisibility—including some knowledge of casting out the nines, if for no other reason than that he should not be ignorant of everything that is not generally usuable. Of course he must be familiar with the various weights and measures in daily use; especially should he have a knowledge of the values of the units of the various systems and how they have been obtained, and are preserved and can be restored if necessary. Then ratio and proportion for use in physics, should be thoroughly taught, as should also the subject of mensuration, which for evident reasons should have a very extended treatment. And let me here observe that whatever of geometry it is best to teach in the grades should be taught with mensuration. A brief treatment of involution and evolution should be introduced teaching the method of extracting square root and cube root by stupidly following a rule in each case, leaving the reasons for these processes for the high school course. The course in arithmetic can then be closed up with a treatment of the subject of percentage and its applica-

tions, and, I am inclined to add, a good treatment of allegation, which is so useful in chemistry and physics. This last subject has been tabooed of late years, we are all aware, but from the necessity which Professor Stevens has found of treating it quite fully in his new work in chemistry, perhaps we have been making a mistake.

And now what should he know about algebra and geometry? Briefly, of algebra, what is known "as up to and including quadratics," and of geometry, what is known as plane and solid and spherical geometry, as treated in any one of a dozen or more good geometries that are now published in this country. Lest this should be taken as a wholesale approval of the average treatise of algebra and geometry, allow a few words in detail. The algebra that this high school graduate should study is one that rests every operation on a solid foundation of principles and reasons; one that takes the utmost pains to prove every proposition and establish every principle just as completely as a proposition in geometry is established. It should contain something more than lists of examples and problems, something more than definitions and rules. It should contain demonstrations that are demonstrations, and they should be so clear and so easy to master that they will stay with one as long as he lives. They should be technical in the least possible sense, containing x as little as possible, and using formulas as little as possible. One case will illutrate. In the proof for the various rules for evolution I am most decidedly in favor of the demonstrations as given in the Olney algebra, and am just as much opposed to the way these rules are demonstrated by the author of most any algebra that has been published in recent years. Of all places where you can make the principles of the decimal system stand out and assert themselves, no such other place presents itself in the elementary mathematics. Here you can teach more of the decimal system and hence of other systems than anywhere else. This algebra should contain, and the teacher teach, and the pupil learn, the subjects of equivalence of equations, inequalities and variation. It should also relegate the system of solving quadratic equations by factoring to a back seat, and push forward to its old position the method of solving by completing the square; and after that is thoroughly ground into the bones, then bring forward the methods of solving by formula and the factoring system. The latter I know is a very interesting and at the present time, a very popular method, and should be thoruoghly taught for future theoretical work; but of late years it has been seated on too high a pedestal and should come down. How many cases of quadratic equations which arise in the practical applications of mathematics can be solved by the factoring method, except by a person who is in constant practice? And there is one other subject we must teach thoroughly and as early in the course as possible; that is the subject of logarithms. It should be taught at least as early as the second year in the high school. However desirable an elementary knowledge of the

rectangular system of co-ordinates and its use in the plotting of various loci; however desirable it is to know how tc use squared paper, and the slide rule, these and perhaps some other subjects might be somewhat sacrificed to afford time for our students to become familiar with the subject and use of logarithms. The fractional and negative exponent can be introduced by definitions in the arithmetic, and logarithms made accessible to students much earlier than is now done.

As to the kind of geometry this high school pupil must master, little needs be said. Several thousand years' use of practically one text has crystalized the subject so that no book is likely to be used can lead us far astray. It is now thoroughly understood that plenty of problems for original solution and demonstration must be introduced to sell any book on geometry. There is one point on which we cannot be too careful and that is not to undertake to generalize too early. It is also a question as to how much of the advanced or modern geometry it is best to introduce; but lack of time in the course will not make an appreciable amount possible. It should not be forgotten that geometry as studied in the high school is not for the sole purpose of preparing a boy or girl for the university. It is not to teach him geometrical facts primarily; it is to teach him to use his mind, and keep it on his business; in a word, to teach him to think, i. e., to teach him to teach himself, the common end of all true teaching.

Now that we have before us what a high school graduate may fairly be expected to know in mathematics, and, having previously admitted that in general he does not know it, the question arises, where does the fault lie? My answer is principally in two parts. It is partly his own fault and partly the fault of his parents and his teachers, but mostly his teachers' fault.

During my connection with the Ann Arbor High School it has been my lot to come in contact with many pupils from many different schools of many different states, as well as to meet daily the pupils who have come into the high school from our own city; and I can assure you that it is as important for the average boy or girl to come from the hands of good teachers as it is for them to come of good parents. I have said that the pupil is partly to blame, and it is true; for unless the pupil makes a conscientious effort, no matter how intensely the teacher tries to teach, little can be accomplished.

It is certain that heredity and environment working through personality are of great value to every one of us all through life, but as we cannot select the ancestors of our pupils or control to any large extent their environment, we must do as we have always done, take them as they are and do our best.

In what respects then are the pupils responsible for their great mental poverty when about to leave the high school? Among all the reasons I can give, what is called lack of will power is perhaps the most fundamental. This deficiency seems to be at the bottom of all

their shortcomings. They do not, in fact they will not when studying, do as they are advised; they will not stick to a sentence or a paragraph till they strike bottom; they will not learn things thoroughly; they will not aim at something, and with their mind on the mark, strive to hit it. On every teaching day of my life I am obliged to listen to pupils try to recite in geometry who do not know the hypothesis, who do not know the conclusion, and of course do not know, nor do they seriously strive to find out, what must be done to prove the proposition; and yet they want to recite, and they want to get through, and they want to graduate. Whether they want to know something is another question. In the solving of problems in either arithmetic, algebra or geometry they persistently refuse to give nine minutes to the study of the problem, trying to discover the relation of the involved quantities, and then take one minute for the solution. They much prefer to take nine minutes for the solution and none for discovery. They rebel against doing the necessary amount of "dead" work in any of the mathematical subjects which they study. Out of a page of twenty--five or thirty problems if they solve the first, tenth and last they think they have done wonders, and some time later when an accurate knowledge of this subject becomes necessary for further advance, they say they have forgotten. No, they have not forgotten; they never had a chance to forget. Another reason why many of our students do not remember their mathematics is because what little they may have known they did not know in the right way. Again, many are willing, and do immense quantities of "dead" work, and take pains to learn things in the right way; and when they leave school they know very much of what they have learned. I have seen some of these students of the latter class who could, twenty years or more after leaving school, solve problems in arithmetic and algebra with nearly as much facility as when in school; even though they had not gone to college or followed teaching or any other calling than business.

And yet again, many of my students would get as many ideas out of a paragraph if they read it backwards as they do in reading it as printed. They seem to have cultivated the art of sounding the printed words properly, but not the art of gaining ideas when they read and study. Strive as hard as one may day after day to teach them that this is folly, they seem illy to realize it. This does not appear to be natural, and one can hardly avoid feeling that there is some good reason for it. Whether the methods used in the kindergarten have been practiced all along the course and have left the pupils in a sieve-like condition, is hard to say. One thing many of us do believe, and that is that kindergarten methods do not develop the will power. However evident it is that "The mind always sees clearly what it really sees, and that we reason amiss only when we speak of what we do not see," however evident this is made to appear, many pupils will try in the next breath to reason and become most heartily discouraged

because they cannot master an idea which they will not allow to enter the mind. The case of the pupil then is simply this: he dislikes immensely to use his brains, and will not do it so long as he can avoid it.

It must not be inferred from the foregoing that all high school students are mentally incorrigible; for it is not so, and the many good and true souls who do their best and who succeed in acquiring a good education are numerous enough to make all our efforts worth while. That more of them are not successful is not alone their fault.

And now how much is the parent and the teacher to blame for the poor results obtained by our schools? That fathers and mothers are responsible as parents and as members of our school boards, to some extent, all will admit. If one could visit the homes of many of our pupils much could be explained and much excused. Still when the conditions seem best, as far as home surroundings go, the pupils are often poorest, and when home surroundings seem poorest the pupils are often the best. That errands must be done, and dishes must be washed, and babies must be tended, are of course conditions not conducive to good scholarship; but if these were the only influences working against scholarship in the home it is quite certain that high school teachers, at least, would not have much cause to complain. The social obligations, the fraternity meetings, the mid-week parties and entertainments of all characters, at inopportune times, are the things that shatter scholarship, and many times also impair good health. The father and mother in the capacity of parents can and should confine these necessary pleasures to reasonable limits and rational hours and times. In the capacity of members of the school board the parents also have serious and responsible duties to perform, not the least of which is to furnish plenty of first-class teachers at reasonable pay. Last semester in talking with one of our students who came from a nearby town, and who had been failing in his algebra, I took occasion to inquire a little into his hisotry. He told me that he had studied algebra one year before coming here. He was first classified in Algebra 3, failed there, and put back into Algebra 2, failed there, and put back into Algebra 1. I asked him what he thought the matter was. Well, he did not know. Didn't you have a good teacher in the school you came from? Why, yes, but she had seventy-five pupils in her room, and I guess she did as well as she could. I think she did. The parents in that community need to think a little more of their children and a little less of their dollars. No teacher should ever have more than twenty-five pupils at a time. A state law obliging boards to pay minimum salaries, and an additional dollar per week per pupil for more than twenty-five children, would have a salutary effect on the product of our schools. The state could reasonably exact this condition now that the primary school fund is so large.

Lastly, what about the share of responsibility for poor results can reasonably be placed upon the teacher? If I was asked to name the

per cent of responsibility that might justly be attributed to him, I should answer anywhere from seventy-five to ninety percent, depending on other conditions, some of which have already been mentioned. Emerson says that "What we most need in this world is somebody to make us do what we can do; this is the work of a true friend." Of course this also means, to show us what we ought to do and then make us do it. As I look back over my school days, the studies I did best in, and learned most about, were the ones in which I had good teachers. Of these there were, unfortunately for me, only three, and one of these was my algebra teacher in the eighth grade. One can almost say that everything depends upon the kind of teachers we have. It is true that some scholars will do well with any kind of a teacher, and some will learn in spite of their teachers, but most of us need wise and constant attention. A student in review algebra once made in substance the following statement: "I had a certain part of the algebra with A. and a certain part with B.; somehow I remember what I had with A., but I do not remember anything about the part I had with B. The same boy, the same subject, but not the same result.

Here then is the first thing a teacher must be able to do to be efficient and successful. He must be able to secure earnest work on the part of his pupils. If the majority of pupils will not work at home, or before coming to class, they must be made to work in the recitation room to make up for it; therefore the teaching cannot be allowed to take on the character of telling, but of making them *tell* you. The operation by which this is done is sometimes called pumping, and if ever you have tried it you have found it to be hard work. That many of our students learn to question themselves systematically and successfully as the result of the constant efforts of their teachers, there is no doubt; and that wise questions and correct answers have been at the root of all success is equally evident, and could be easily illustrated.

The questioning method of teaching is the one that brings the teacher into close contact with his pupils and determines whether or not the pupil has been in close contact with his lesson; and it might also be observed, whether the teacher has been in close contact with his subject. There is not enough pains taken, all through the high school, at least, to see to it that every capable student does the work that is set for him to do. It takes time and hard work to look over examination papers, as well as other set tasks; but in this way only can a teacher be sure that each pupil has done the necessary work, especially in mathematics. I think I will tell how I once saw a teacher fail to make contact with his pupils. It was in a recitation on a day when the lesson consisted of a certain number of problems (not examples). On entering the room the scholars were all sent to the board and each given a problem to solve. The teacher took a seat and waited for results. One after another, some of the solutions were completed, and the teacher, armed with a set of answers, indicated whether the

answer was right or wrong. If it was right, the problem was immediately erased by the pupil and another assigned for solution. Not one question was asked, not one thing was done to determine whether the solution was a satisfactory one, or whether it was a solution at all. All that the teacher knew was that at the close of the writing on the board was the same number that was found on a certain page and line of the answer book. The pupil could have found this out with the answer book without the aid of the person who was supposed to be a teacher. At the close of the recitation period, not one-half of the students had finished their problems; but a new lesson was assigned for the next day, when it is fair to suppose the same operation was gone through with as before. Not one person in this hearing calls this teaching, not one here present but knows that such work is a fraud, and the teacher who teaches in this way is the worst kind of a grafter; nothing but a drawer of breath and a drawer of salary. And I will guarantee that though there was enough breath drawn, there was drawn too much salary, however small it may have been. This was infinitely poorer teaching than my teacher of algebra used to do in the high school when she would determine if we had solved our examples right by comparing our solutions with hers which she had written out on paper. To simply do in mathematics, to get the answer, is not the only thing desirable, even when you do right and get right answers. To know how it is done and know why it is done are of more importance. To have the right answer is important, but it is the last thing of importance. For the university boy or girl, as well as for the school boy or girl, there is nothing more important than the why, than the theory. To study the problem and discover relations, to talk before the class and explain these relations are things of the utmost importance, and any teacher that does not devote more than half the recitation period daily to this kind of work is failing and giving plenty of reason why high school boys and girls are so poorly equipped.

To take each equation in a solution and fully tell how you obtained it, and the next equation following, stating the principles used and telling all about it, are the things that are worth doing; these are the things that will stay with one through life, that make mathematics a live subject, and a powerful subject for intellectual development and discipline.

In contrast to this method of teaching is the method sometimes used by mathematical sharks who constantly strive to impress their own great mathematical superiority by using and teaching short cuts. On this point I wish to quote a few sentences from the preface of Finkle's "Mathematical Solution Book": "It will not be denied by any intelligent educator that the so-called 'short cuts' and 'Lightning Methods' are positively injurious to beginners in mathematics. All the 'whys' are cut out by these methods and the student robbed of the very

object for which he is studying mathematics, viz., the development of the reasoning faculty, and the power to express his thoughts in a forcible and logical manner. By pursuing these methods mathematics is made a memory drill, and when the memory fails, all is lost; whereas it should be presented in such a way as to develop the memory, the imagination, and the reasoning faculty. It cannot be denied that more time is given to, and more time wasted in the study of mathematics in our public schools than in any other branch of study. The reason for this, to my mind, is apparent. Pupils are allowed to combine the numbers in such a way as to get the answer, and that is all that is required. They are not required to tell why they do this, and why they do that, but, 'did you get the answer?' "

Mathematics taught and learned in the right way cannot easily be forgotten. But even though much of its detail may slip away from us, the mental results are as lasting as the everlasting hills. Disciplinary results are what we must strive for in all teaching. This injunction is now laid upon us with as much if not more force than in the days when the number of classical graduates from our high schools outnumbered all other courses. At present, as you all know, the egineering section is the largest; and even though this condition would seem to call for better students in mathematics than formerly, there are many who honestly believe that we do not have as many good students in mathematics now as we used to have when more were studying Latin and Greek, and fewer were playing with "fads and fancies."

This being better teachers, and bringing our students closer to their work and ourselves and making them familiar with all its details, is in the air all about us; and we teachers of mathematics in the public schools must not fail to have it include us. Old methods that have failed or have outlived their usefulness must be cast aside, and the new ones adopted. Only recently, Dr. Darling, of our medical department, told me that he had discarded old methods of instruction, and that now instead of trying to teach by the wholesale and at arm's length, he takes four students into the operating room with him, and they not only see but help him and tell him what to do. So we must take our students with us and interest them deeply in their work and our work, if we wish to accomplish worthy results.

There are numerous other reasons why we are not producing satisfactory results; but time forbids that I should more than mention two or three of them.

Many times we make the mistake of assigning problems that are too difficult for our students, and to advance them to a higher grade before they have completed the work of the lower grade. A teacher of music is very careful not to give a pupil a piece of music that is too difficult. If she does, disaster is meted out instantly. We teachers of mathematics should be equally wise, and not give our students work that is too difficult for at least the average pupil in the class. For this

reason it is very necessary that the proper kinds of texts should be used in the various parts of the course. Three grades of arithmetic and two of algebra should be provided. There is no doubt at all but what we are making a very serious mistake when we undertake to teach the beginners in algebra from the same text as that used by those who are completing the subject. My experience on this point is such as to make me feel positive that it is a very grave error for us to continue longer in this course. We should by all means use an elementary text with the beginners.

Another reason why we fail to produce desired results is because of the time when these subjects are taught in our courses. The arithmetic taught in the grades should be completed by the end of the first half of the eighth year. If some geometry, so-called, is taught in this year, it also should be out of the way by this time, and the study of algebra should be begun and continued for the remaining half-year, and the work in mathematics continued in the high school about as follows:

8		9		10		11		12	
	Alg.	Alg.		Arith. & Logs.		Alg.	Alg.	Geom.	Geom. & Rev. Alg.

or as follows:

8		9		10		11		12	
	Alg.	Alg.		Arith. & Logs.	Alg.	Alg.	Geom.	Geom.	Trig. & Rev. Alg.

It will be noticed that little or nothing has been said about the teaching of geometry. The truth is that most that has been said is just as applicbale to geometry and trigonometry as to arithmetic and algebra. Geometry is to a large extent a disciplinary and a culture study; although its practical applications are just as numerous and just as useful as are those of the other mathematical subjects. Geometry is harder to teach and harder to learn, and its problems more difficult for high school students to solve than are those of the arithmetic and algebra, and yet it is probably true that more students fail in their advanced work in mathematics in college through a poor preparation in algebra and arithmetic than for any other cause.

It will be noticed that I have said nothing about the amount of mathematics required of our graduates either for graduation into business or for entrance into college. I have nothing to say, except that I think the requirements for either or both are just about what they

should be, even though there is some agitation in the east to reduce the amount for entrance to college.

In conclusion, "knowledge" has been defined as the "Abiding result of some action of the mind." It is theerfore necessary if we wish our pupils to acquire knowledge we must see to it that their minds are put in action. They must do their share, and I hope I have made it clear that the teacher must do his share.

HISTORY CONFERENCE

REPORTED BY EDITH M. KIMBALL, DETROIT EASTERN HIGH SCHOOL, SECRETARY OF THE HISTORY GROUP

The principal features of the meeting of the History Group consisted of the first report of the Committee on Recent Publications of Interest to Teachers of History, read by the chairman, Principal Webster Cook, and an address by Professor Andrew McLaughlin on "The Significance of Party Organization in American History." The greater portion of Mr. Cook's report is given in this number of the Proceedings. It is with intense regret that we are unable to publish the characteristically interesting "talk" given by Professor McLaughlin.

In the business meeting, a constitution was proposed by the Committee on Organization, and adopted. This was the result of a feeling among those interested in the history of the Michigan Schoolmasters' Club, that a closer organization of that group ought to be effected, and an effort made to gain the active co-operation of all those interested in historcal study. The great dfficulty to be encountered in bringing about an effective organization is, that so large a number of those teaching history are doing so simply to fill up their hours, and expect to drop out of it in a term or two. Then, too, many teach history who are planning to leave the profession for others for which they are fitting themselves in the meantime. These teachers, of course, cannot be interested in anything to further the development of historical study. This condition is felt to be in a sense peculiar to the history work. One hardly undertakes to fill in hours with science or language unless he has had some special preparation or interest in the subject, but any one may have an hour or two of history given him to teach, though his specialty may be language, science or athletics.

Because so large a proportion of the teaching force is variable and uncertain, it seems doubly urgent that those who are truly interested in the development of historical study should take a very active part in planning for its furtherance. To this end the committee presented

a constitution, to serve merely as a working plan, not considering it complete or even adequate, but hoping thereby to accomplish an organization which can develop or change it, as becomes necessary.

CONSTITUTION

Article I—Name and Purpose

This body shall be known as the History Group of the Michigan Schoolmasters' Club. Its purpose is the advancement of the study of history as a means of education.

Article II—Membership

Any person who is eligible to membership in the Michigan Schoolmasters' Club and who is interested in the advancement fo the study of history as a means of education, shall be eligible to membership in the History Group.

Article III—Officers

The officers of this body shall be a chairman and a secretary, to be elected at the annual meeting, and an executive committee consisting of the above named officers, together with five other members to be appointed by the chairman. The executive committee shall have general direction of the work of the group.

Article IV—Meetings

The annual meeting shall be held at the time of the annual meeting of the Michigan Schoolmasters' Club. All questions in regard to the holding of any other meetings shall be subject to decision by the executive committee.

Article V—Process of Amending

This constitution may be amended at any annual meeting by a two-thirds vote of the members present, provided that the proposed amendment is recommended by the executive committee.

Acting in accord with this constitution, the group chose as chairman for the ensuing year, Professor Earle W. Dow, of the University, and as secretary for the same period, Miss Edith Kimball, of the Detroit Eastern High School.

The chairman appointed to be members of the executive committee for 1906-1907, along with the chairman and secretary: Miss Mary B. Putnam, Normal College; Professor G. W. Bell, Olivet College; Principal Dean Lawrence, Alpena; Miss Mabel Steward, Michigan Seminary, Kalamazoo; and Mr. J. B. Davis, Detroit Central High School. As members of the committee on "Recent Publications of Special Interest to Teachers," he appointed Principal Webster Cook, of Saginaw,

chairman; Professor A. L. Cross, of the University; and Mr. Charles Estrich, of the Northern State Normal, Marquette.

The round-table conference on the work in ancient history, confined itself to the discussion of (a) How may we best secure the interest of the first year pupils? (b) To what extent should we teach the constitutional history of Greece and Rome in the first year? The general opinion, as expressed, seemed to be that as the year in ancient history is the only history that half or more than half of the pupils ever have, it seems necessary so to interest them in historical study that more will desire to continue the study, or be eager to read along that line.

In order to create interest it was suggested that the dramatic side be emphasized, causing characters and individuals to stand forth, the conditions and times being understood through them; also that the child be helped to place himself in the atmosphere of the people whom he is studying, by means of visual and word pictures, and narrative in the first person.

The opinion seemed to prevail that constitutional history, to the extent presented in an ordinary text-book, could be taught without loss of interest, and with understanding. That the general functions of our own government should first be made clear; whenever possible, comparisons should be made, and the pupil made to understand why changes take place, and just what changes follow certain conditions.

THE REPORT OF THE COMMITTEE ON RECENT PUBLICATIONS OF INTEREST TO HISTORY TEACHERS

In his report Mr. Cook mentioned new editions of Bryce's "Holy Roman Empire"; Henderson's "History of Germany," in one volume; "Traill's Social England," and the Autobiography of Andrew D. White. He called special attention to several works newly brought before the public. To quote him:

"The first one I will mention is the 'Historians' History of the World,' put on the market in this country by the Outlook Company. This is a work of twenty-five volumes and is peculiar in one important feature. It is made up mainly of direct quotations from the great historical writers, so woven together as to give a continuous narrative. What I have to say about this and the other works that I shall mention is solely from one point of view, that of the value of these works as reference books in connection with our classes in American history. I am not attempting to make a general criticism.

"As its title indicates, this is a history of the world from prehistoric times down to the election of President Roosevelt in 1904. It is thus the history of many different peoples, of many different times and places. It results that not very much time can be given to any

one time or nation. It is not a treatise on any particular subject or phase of history, and is not full enough in its detail to be placed under the head of valuable works. For example, let us examine the history of the United States. If we leave out of consideration the preliminary material which would not be found in an ordinary text-book, the space devoted to that portion of the history used in schools is not much greater, for example, than that in Channing's 'Student History of the United States.'

"But there is a more serious difficulty in connection with this work. The text is made up mainly of quotations from various authors, some of them of considerable length, some of them very short. It sometimes happens that a single paragraph is made up of a number of quotations strung together. Now every author has his own point of view, his own attitude towards his subject, and it thus happens in a paragraph so constructed that the point of view is constantly changing. Perhaps the experienced reader can allow for this constantly changing tone and weigh the paragraph accordingly. But the high school student cannot, and what should be the real and proper effect of the paragraph is consequently lost.

"A similar difficulty applies to larger portions of the work. Let us take, for example, the treatment of Columbus. A not very successful attempt is made at the beginning to give both sides of Columbus' character. He was not all bad or all good. On his bad side he is said to have been no worse than Bobadilla, who at one time made him so much trouble. Further along Bobadilla is spoken of as one of the vilest of men, in sharp contrast with Columbus' virtues, and in the end Columbus is eulogized as one of the very greatest of earthly heroes. Such changes in tone and spirit the experienced reader again may be able to allow for, but they utterly unfit the book for a reference book for high school pupils.

"I next want to speak of a work that has just come to hand. It is entitled 'Great Events by Famous Historians,' and is made, according to its title page, on a 'plan evolved from the consensus of opinions, gathered from the most distinguished scholars in America and Europe,' and is a 'comprehensive and readable account of the world's history,' a 'complete narrative in the master words of the most eminent historians.' The work is edited by Rossiter Johnson. This is a work of twenty octavo volumes, excellently bound, and with illustrations partly in colors taken from famous paintings.

"The first volume I happened to examine covered the period from 1861 to 1872. The first article in this volume is a brief, general account of this period, too brief to be important. The next topic is entitled 'Secession of the Southern States." The two authors quoted from are Jefferson Davis and Abraham Lincoln. The selection from Davis is taken from his 'Rise and Fall of the Confederate Government,' and from Lincoln are given his inaugural address, and his first message to

Congress. All these selections are inconsistent with the title page. Neither of these writers is a historian, nor are the selections history. They all furnish much material from which history might be made, and if the work were made up entirely of such, it might be valuable as a source-book, but the other selections are of a different kind.

"Other topics, taken in order given in the book are: 'The Battle of Bull Run,' by Horace Greely; the 'Monitor and the Merrimac,' by John D. Champlain; 'The Capture of New Orleans,' by Royal Farragut· 'McClellan's Peninsular Campaign,' by Rossiter Johnson; 'Emancipation,' by Abraham Lincoln, etc., for twenty-four other topics. As there are less than four hundred pages in the volume, the selections average about a dozen pages each.

"From this it is evident that this is no consecutive history at all. In connection with our great Civil War, for example, about a dozen battles are described. The real progress of the war is nowhere shown, nor is its character nor its results. If one wants a series of brief articles for entertaining reading, the work abounds in them, as many of the accounts are excellent, though not all are reliable. But for serious work it is useless. It has no place among reference books for the school."

He then calls attention to a work of an entirely different kind, Professor Osgood's "American Colonies in the Seventeenth Century": " 'It is intended to exhibit in outline the early development of English colonization in its political and administrative side. At the same time it is a study of the origin of English-American political institutions.' It shows the various phases through which colonization schemes passed, it shows the difference in the character of the various grants and charters, and in the resulting settlements, and traces the various movements out of which the institutions gradually developed. Even from the point of view of general history, this work furnishes much valuable information, and must rank among the best of reference books for our earliest history." Attention was also called to the "American State Series," edited by Professor Willoughby, and published by the Century Company.

SYNOPSIS OF BUSINESS MEETING

UNIVERSITY HALL, March 31, 1906.

The meeting was called to order by President A. S. Whitney. The minutes were read by the secretary, Louis P. Jocelyn. Reports were made by the secretary, the treasurer, J. P. Everett, and the chairman of the auditing committee, E. A. Lyman.

REPORT OF AUDITING COMMITTEE.

Total receipts in hands of the Secretary	$499.66
Total receipts in hands of the Treasurer	57.00
Total	$556.66
Total disbursements by the Secretary	$423.05
Total disbursements by the Treasurer	57.00
	$480.05
Balance on hand March 1, 1906	76.61
Total	$556.66

Accounts found correct.

E. A. LYMAN,
C. W. MICHENS,
Auditing Committee.

FINANCIAL REPORT OF THE SECRETARY.

Receipts.

March 22, 1905—Balance	$ 17.16
March 23, 1905—Deposited fees	19.00
April 1, 1905—Deposited fees from Treasurer	326.70
April 8, 1905—Deposited fees	13.00
July 22, 1905—Deposited fees	3.00
Nov. 18, 1905—Deposited from U. of M.	70.00
Dec. 28, 1905—Deposited	.80
Feb. 10, 1906—Deposited from Normal College	50.00
Total	$499.66

Disbursements.

April 7, 1905—Cheque No. 20, piano	$ 5.00
April 7, 1905—Cheque No. 21, Prof. L. H. Bailey	33.35
April 8, 1905—Cheque No. 22, moving piano	5.00
April 8, 1905—Cheque No. 23, postage	2.00
April 13, 1905—Cheque No. 24, clerk hire for year	21.20
May 6, 1905—Cheque No. 25, printing account	129.45
May 16, 1905—Cheque No. 26, janitor	2.00
July 22, 1905—Cheque No. 27, badges	4.50
July 22, 1905—Cheque No. 28, postage	2.00
Oct. 17, 1905—Cheque No. 29, postage	5.00
Oct. 23, 1905—Cheque No. 30, postage	2.40
Oct. 24, 1905—Cheque No. 31, postage	3.00
Dec. 28, 1905—Cheque No. 32, printing account	100.00

Dec. 29, 1905—Cheque No. 33, printing account in full		96.90
Jan. 13, 1906—Cheque No. 34, postage		2.00
Jan. 13, 1906—Cheque No. 35, stationary		3.25
Feb. 7, 1906—Cheque No. 36, Michigan Passenger Ass'n		6.00
	Total	$423.05
	Balance on hand March 1, 1906	76.61
	Total	$499.66

REPORT OF THE TREASURER.

Receipts.

March 22, 1905—Balance	$123.16
Received from dues	277.70
Received from the Secretary	155.80
Total	$556.60

Disbursements.

March 30, 1905—Paid Pres. Woodrow Wilson	$ 45.00
April 1, 1905—Paid Prof. James R. Angell	12.00
Paid through the Secretary	423.05
Total	$480.05
Amount in bank, balance March 1, 1906	76.61
Total	$556.66

NOMINATING COMMITTEE.

Appointed Friday Morning, March 30.

S. O. Hartwell, representing the club at large—Kalamazoo.
L. P. Jocelyn, representing the club at large—Ann Arbor.
F. W. Kelsey, representing Classical Conference—University.
H. M. Randall, representing Physics Conference—University.
W. S. Leavenworth, representing Chemical Conference—Olivet College.
Mary Goddard, representing Biological Conference—Normal College.
J. L. Markley, representing Mathematical Conference—University.
J. B. Davis, representing Historical Conference—Detroit.
Clyde Ford, representing Modern Language Conference—Normal College.
C. B. Merrill, representing English Conference—University.

REPORT OF THE NOMINATING COMMITTEE.

President, David Mackinzie—Detroit Central.
Vice-President, Miss Lucy Sloan—Central Normal.
Secretary, Louis P. Jocelyn, Ann Arbor.
Treasurer, John P. Everett—Mt. Clemens.

Chairman of the Classical Conference—J. H. Drake—University.
Secretary of the Classical Conference—B. L. D'Ooge—Normal College.
Chairman of the Physics Conference—N. F. Smith—Olivet College.
Chairman of the Chemical Conference—B. W. Peet, Normal College.
Secretary of the Physics and Chemical Conference—De Forest Ross—Ypsilanti.
Chairman of the Mathematical Conference—C. B. Williams—Kalamazoo College.
Secretary of the Mathematical Conference—L. C. Karpinski—University.
Chairman of the Modern Language Conference—A. G. Canfield—University.
Secretary of the Modern Language Conference—Ernest Lutz—Albion College.
Chairman of the Historical Conference—E. W. Dow—University.
Secretary of the Historical Conference—Edith Kimball—Detroit Eastern.
Chairman of the English Conference—J. H. Harris—Pontiac.
Secretary of the English Conference—Cornelia Hulst—Grand Rapids.

Chairman of the Biological Conference—S. O. Most—Hope College.
Secretary of the Biological Conference—Ella Bennett—Ann Arbor.

Mr. B. A. Finney of the University made a report of the Committee on the Conditions of the Libraries of the Schools of the State. The report was accepted, and the Committee continued.

A vote of thanks was extended to all who assisted in making the meeting one of the best in the history of the Club.

COMMITTEE ON NEW CONSTITUTION AND BY-LAWS.

*J. O. Reed—University.
L. P. Jocelyn—Ann Arbor.
David Mackinzie—Detroit.
J. H. Drake—University.
E. A. Lyman—Normal College.

*On account of illness Mr. Reed did not act on the Committee.

In the absence of the Chairman, through illness, the Secretary read the report of the Committee on a New Constitution and By-Laws and after a few modifications the report was accepted and adopted and made the governing laws of the club. The report as accepted and adopted is as follows:

ARTICLES OF ASSOCIATION OF THE MICHIGAN SCHOOLMASTERS' CLUB

Article I—*Name*

The association shall be known as the Michigan Schoolmasters' Club.

Article II—*Place of Office*

The office of the club shall be located in the city of Ann Arbor.

Article III—*Object*

The object of the club is to further the common interests of the schools, colleges and university of the state.

BY-LAWS

Article I—*Time and Place of Meeting*

The club shall hold an annual meeting in the city of Ann Arbor. The time of meeting shall be determined upon by the Secretary upon the advice of the Executive Committee.

The general meetings of the club shall be held on Thursday and Friday mornings, and the conferences of the club may be held at any time during the same week except on Thursday and Friday mornings.

Article II—*Membership*

Any person actively engaged in any branch of educational work may become a member of the club upon payment of the annual or life membership dues. A person ceases to be a member of the club when his annual dues remain unpaid one month after the last annual meeting.

Article III—*Dues*

The annual dues of the club shall be one dollar; life membership ten dollars. All life membership dues shall constitute an endowment fund and shall be placed at interest.

Article IV—*Officers*

The officers of the club shall be a President, Vice-President, Secretary, Treasurer and an Executive Committee.

Article V—*Election of Officers*

On the first day of the general meeting the president shall appoint a committee composed of three members from the general session and one each from the different conferences, to present candidates for all

officers of the club, including the chairmen and secretaries of the different conferences. Each committeeman representing his conference shall present the names of candidates nominated for office by his particular conference, and in case no such nominations are made *he* shall make the nominations.

The committee as a whole shall nominate persons for the positions of President, Vice-President, Secretary and Treasurer of the club, and shall receive the nominations made by each conference, or by its committeeman, and shall be sole judge of the qualifications of each nominee.

No person shall be elected to any office who is not a member of the club, or whose dues for the coming year are not paid, or who has held the office to which he is elected for the two previous years. The time limit of this law shall not apply to the positions of Secretary and Treasurer.

Article VI—*Time of Election of Officers*

The time of election of officers of the club shall be on the morning of the last day of the general meeting.

Article VII—*Method of Election*

Unless otherwise ordered the election of all officers shall be by ballot.

Article VIII—*Tenure of Office*

The general officers of the club, except the Secretary, shall be for one year; those of the conferences, except the Secretary, for not more than two years; and all officers shall hold office until their successors qualify.

Article IX—*Duties of Officers*

(a) *President*

It shall be the duty of the President to preside at the annual meetings and at the meetings of the Executive Committee. He shall be responsible for the program of the general sessions of the club, and shall perform such other duties as generally pertain to the office of President.

(b) *Vice-President*

It shall be the duty of the Vice-President in the absence of the President to perform all the functions pertaining to the President. He (she) is a member of the Executive Committee.

(*c*) *Secretary*

The Secretary shall be the permanent officer of the club and shall be responsible for the general welfare and policy of the club. He shall have general supervision of the club when not in session, and, with the President and the Chairmen and Secretaries of the different conferences; shall be responsible for the nature and plan

of all programs issued by the club and the proper distribution of the same. The Secretary shall have power to collect, to hold, and to disburse, in the interests of the club, any money in his possession belonging to the club. Provided, however, that he shall deposit in a bank all money received and, further, that he shall pay out money only by check detached from the usual stub-form. It shall be his duty to give, each year, to the auditing committee, a written financial statement of his account with the club. He shall turn over to the auditing committee the bank stub-book and the canceled checks, which stub-form and canceled checks shall be returned to him. He shall also furnish the Treasurer of the club a duplicate of his report to the Auditing Committee, which report the Treasurer shall make part of his own report.

The Secretary shall read his financial report at the business meeting of the club, and shall also give an annual report of the general condition of the affairs of the club.

He shall have charge of the records and correspondence of the club, and shall keep a list of all teachers who attend the meetings and of all persons taking part in its programs.

He shall collect for publication the addresses delivered and the papers read before the club and before the different conferences, unless otherwise provided for. He shall edit the official proceedings, have them printed in proper form and shall distribute the same to the members of the club.

To assist him in the performance of his duties, the Secretary shall be allowed a definite salary, the amount of which shall be determined upon each year by the Executive Committee.

(*d*) *Treasurer*

The Treasurer shall have power to collect dues and pay out in the interests of the club any funds in his possession. Before the annual meeting he shall prepare a financial report for the Auditing Committee and shall read such report at the business meeting, and turn the same over to the Secretary for publication in the proceedings.

The Treasurer shall receive an account of the receipts and disbursements of the Secretary and shall incorporate the same in his report. He and the Secretary shall deposit all money belonging to the club in the city where the office of the club is located. After money is deposited in the bank by the Treasurer he may draw out any portion of the same by an order on the Secretary.

(*e*) *The Executive Committee*

The Executive Committee shall be composed of the President, Vice-President, Secretary and Treasurer of the club, together with the chairmen of the different conferences. It shall meet upon the call of the Secretary of the club and shall be entrusted with the general

policy of the club. It shall have power to fill all vacancies occurring when the club is not in session, to settle all controversies, and, in general, it shall have charge of all of the weightier matters of the club.

Article X—*Conferences of the Club*

All conferences shall be under the general management of the club. Their control and general policy shall be in the hands of the Executive Committee. Their Chairman shall be chosen every year and no person may act as Chairman of his particular conference for more than two years in succession. Their Secretary may be elected for a period of three years.

The Chairman of each conference is a member of the Executive Committee. No person shall be elected to any office in the conference who is not a member of the club or who is in arrears in dues. (This clause does not restrain an official Chairman from appointing any person as Acting Chairman at any particular session.)

Each conference in turn shall be assisted by the club in arranging a special program. To this end the Secretary of the club shall enter into an agreement with the Chairman of such conference to furnish funds (to a reasonable amount) to bring before the conference the most eminent men in their particular line of work. The conference holding this special session may be allowed more than the usual time required for its meetings.

Article XI—*Auditing Committee*

The President shall appoint each year two members of the Executive Committee to examine the accounts of the club and to report the condition of the same at the annual meeting.

Article XII

These By-Laws may be amended by a majority of the members present at any annual meeting upon twenty-four hours notice being given.

PROGRAM OF GENERAL SESSIONS

Friday Morning

1. The Educational Import of Modern Thought,
   Professor John T. McManis, Western Normal.
2. Evolution and Moral Education,
   Dr. Theodore de Laguna, University of Michigan.
3. The Nature of the Child,
   President E. G. Lancaster, Olivet College.

Friday Afternoon

President W. O. Thompson, University of Ohio.
Young Ladies' Class in Gymnastic Drill and Basket Ball Game.

Friday Evening

Concert, by Sousa's Band.

Saturday Morning

1. Over-Pressure in High Schools,
   Mr. Jesse Davis, Central High School, Detroit.
2. Self-Activity in Education: Its Meaning and Conditions,
   Professor John Dewey, Columbia University.
3. Business meeting.

PROGRAM OF CONFERENCES

CLASSICAL CONFERENCE

Thursday Morning

1. Latin in Michigan High Schools in Ten Years, 1896 to 1905 (statistics shown by the stereopticon),
   Principal George R. Swain, Bay City High School.
2. Discussion of Principal Swain's paper,
   Principal David Mackenzie, Central High School, Detroit.
   Professor B. L. D'Ooge, Michigan State Normal College. (See also No. 13.)
3. Elision in Latin Verse,
   Professor Albert G. Harkness, Brown University.
4. Recent Excavations of Roman Remains in Britain: Silchester and Caerwent,*
   Dr. George H. Allen, University of Cincinnati.
   This paper will be printed in full, with illustrations, in *Records of the Past*, early next fall.
5. Some Ancient Roman Lamps,*
   Professor E. W. Clark, Ripon College, Wisconsin.
   Printed in full, with illustrations, in *Records of the Past*, for June.
6. The "More Ancient" Dionysia at Athens: A Note on Thucyd. II, 15,
   Professor Edward Capps, University of Chicago.
   To be published in full in *Classical Philology*, Vol. I, No. 4.
7. Is the Aeneid a Complete Poem?
   Principal Maude A. Isherwood, Grand Haven High School.

Thursday Afternoon

SYMPOSIUM†

on the value of literary, and particularly classical, studies as a preparation for the study of the professions.

8. The study of Greek and Latin as a preparation for the Study of Medicine,
   Dr. Victor C. Vaughan, Dean of the Department of Medicine and Surgery, University of Michigan.

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*Illustrated with the stereopticon.

†The Symposium will be continued, with a discussion of the value of humanistic studies as a preparation for the study of Law and of Theology, at the Classical Conference of 1907.

9. Discussion of Dr. Vaughan's paper,
   Dr. Charles B. G. de Nancrede, Professor of Surgery, University of Michigan.
10. The Place of Humanistic Studies in the Preparation of a Student of Medicine,
    Dr. Wilbert B. Hinsdale, Dean of the Homœpathic Medical College, University of Michigan.
11. The Value of Humanistic Studies as a Preparation for the Study of Engineering,
    Herbert C. Sadler, Professor of Naval Architecture, University of Michigan.
12. Discussion of Professor Sadler's paper,
    Gardner S. Williams, Professor of Civil and Hydraulic Engineering, University of Michigan.
    George W. Patterson, Professor of Electrical Engineering, University of Michigan.
    J. B. Davis, Associate Dean of the Department of Engineering, University of Michigan.

    The "Symposium" is printed in full in the *School Review* for June.
13. Five-minute discussions of this subject, and of the conditions revealed by Principal Swain's paper (No. 1),
    Principal F. L. Bliss, University School, Detroit.
    Superintendent W. G. Coburn, Battle Creek.
    Principal J. R. Bishop, Eastern High School, Detroit.

JOINT SESSION OF THE CLASSICAL AND MODERN LANGUAGE CONFERENCES

Thursday Evening

14. The Survival of the Classical Epic Tradition in Mediæval Literature,
    Dr. George L. Hamilton, University of Michigan.
15. The Influence of the Roman Law upon the Legal Systems of Modern Europe and America,
    Professor Joseph H. Drake, University of Michigan.

Friday Afternoon

16. The Autobiographical Element in Latin Literature and Inscriptions,
    Professor Henry H. Armstrong, Juniata College, Pennsylvania.
17. The Birth of Venus: A Greek Relief and a Renaissance painting,*
    Dr. Samuel A. Jeffers, California State Normal School, Pennsylvania.

    To be published in full in *Records of the Past* for July.

*Illustrated with the stereopticon.

18. The Tenth Satire of Juvenal and Dr. Johnson's Vanity of Human Wishes,
    Mr. Frank E. Potter, Geneva High School, New York.
19. Present Schools and Theories of Latin Grammar.
    Professor John C. Rolfe, University of Pennsylvania.
    This will be published in the *School Review.*
20. Maron: A Mythological Study,
    Dr. Charles B. Newcomer, University of Michigan.
    To be published in full in *Classical Philology.*
21. The Roman Forum in the Summer of 1905,*
    Professor Walter Dennison, University of Michigan.
22. Question Box.
    All persons attending the Conference are invited to hand to the presiding officer on Friday afternoon any questions which they would like to have discussed at the Classical Conference of 1907; and to make suggestions regarding the speakers whom they would be pleased to hear.

CONFERENCE OF PHYSICS AND CHEMISTRY

Thursday Afternoon

1. The Equivalent Weight of Magnesium,
   Mr. E. A. Clemans, Central High School, Detroit.
2. Address: Are the Elements the Ultimate Constituents?
   Professor S. L. Bigelow, University of Michigan.
3. The Chemistry of the Bread We Eat,
   Mr. DeForest Ross, High School, Ypsilanti.
4. The Reference Library for Chemistry,
   Professor B. W. Peet, State Normal College.
5. Student's Method for Determining the Volume Weight of Hydrogen,
   Mr. R. R. Putnam, Eastern High School, Detroit.
6. A Series of Combining Weight Determinations,
   Mr. J. W. Matthews, Western High School, Detroit.
7. Method of Classifying the Inorganic Acids for Analysis,
   Professor W. S. Leavenworth, Olivet College.

Friday Afternoon

1. An Experiment in Thermal Conductivity,
   Mr. H. L. Curtis, Michigan Agricultural College.
2. The Use of the Alternating Current in the High School.
   Mr. H. L. Parrott, Saginaw.
3. Alternating Current Experiments,
   Mr. A. O. Wilkinson, Western High School, Detroit.

4. Address: The South African Meeting of the British Association for the Advancement of Science. (Illustrated by stereopticon),
   Professor Henry S. Carhart, University of Michigan.
5. The Entrance Requirements in Physics and its Relation to the Physics of the College Course,
   Professor N. F. Smith, Olivet College.
   Professor C. W. Green, Albion College.
6. Boyle's Law Apparatus,
   Mr. C. D. Carpenter, Michigan State Normal College.

Saturday Afternoon

1. A Model for an Adjustable Cross-bar for a Laboratory Table,
   Mr. C. M. Bronson, Toledo, Ohio.
2. The Undercooling of Acetic Acid,
   Mr. C. F. Adams, Central High School, Detroit.
3. The Nernst Lamp in the Laboratory and Simple Experiments on Radio-Activity,
   Professor Fred N. Gorton, Michigan State Normal College.
4. A Convenient and Inexpensive Adjustment for a Galvanometer Scale,
   Mr. W. H. Hawkes, Ann Arbor High School.
5. A Simple Apparatus for Parallel Forces,
   Mr. DeForrest Ross, Ypsilanti High School.
6. An Apparatus for the Parallelogram of Forces,
   Mr. M. A. Cobb, Lansing High School.
7. Apparatus for Demonstrating Laws of Fluid Pressure,
   Mr. H. C. Krenerick, Berwyn, Ill.

JOINT MEETING BIOLOGICAL CONFERENCE AND SCIENCE TEACHING

Friday Afternoon

1. Laboratory Work in Biology, as Related to Field Work,
   Dr. J. G. Needham, Lake Forest College, Ill.
2. Laboratory Work in Biology, its Nature, Conduct and Value,
   Dr. Louis Murbach, Central High School, Detroit.
3. Laboratory Work in Physiography, as Related to Field Work,
   Professor M. S. W. Jefferson, State Normal College, Ypsilanti.
4. Laboratory Work in Geography,
   Professor L. H. Wood, Western State Normal School, Kalamazoo.

MATHEMATICAL CONFERENCE

Friday Afternoon

1. Mathematics in and below the High School,
   Mr. L. D. Wines, Ann Arbor High School.
2. The Teaching of the Theory of Interest and Insurance Mathematics in Universities, Colleges, and High Schools of this Country,
   Professor J. W. Glover, University of Michigan.
3. Geometry as an Experimental Science.
   Dr. W. B. Ford, University of Michigan.

HISTORY CONFERENCE

Friday Afternoon

1. First Report of Committee on Recent Publications of Special Interest to Teachers of History,
   Principal Webster Cook, Saginaw, Chairman of the Committee.
2. The Significance of Party Organization in American History,
   Professor Andrew C. McLaughlin, University of Michigan.
3. Business, including report of the Committee on Organization.
4. Round-Table Conference on the Work in Ancient History. Room 2, Tappan Hall.
   Leader, Miss Edith Kimball, Eastern High School, Detroit.

Questions for Discussion:

(a) How may we best secure the interest of the first year pupils?

(b) To what extent should we teach the constitutional history of Greece and Rome in this first year?

5. Round-Table Conference on the Work in Medieval and Modern History. Room 7, Tappan Hall.
   Leader, Mr. Charles H. Estrich, Central State Normal, Mt. Pleasant.

Questions for Discussion:

(a) How can we best establish the correlation of events in the different European nations?

(b) How can we cover the important developments of the medieval period, and find time to give an adequate idea of the present situation in Europe?

MODERN LANGUAGE CONFERENCE

Friday Afternoon

1. Some Experiences in Teaching French,
   Miss Ethel Gregg, Central High School, Detroit.

2. Essentials often Disregarded in the Teaching of Advanced German in Secondary Schools,
   Miss Carolyn A. Humphrey, Muskegon High School.
3. What Should be the Nature of the Sentences used in Drill in Beginning French Classes?
   Professor H. R. Brush, Hope College.
4. The Direct Method,
   Miss Marie Zimmerman, Saginaw E. S. High School.
5. Some Indispensable Factors for Americans Teaching Foreign Language and Literature,
   Professor J. Perry Worden, Kalamazoo College.

Saturday Morning

1. Recent Theory and Practice in French Verse,
   Professor H. P. Thieme, University of Michigan.
2. Resume of the New International Language "Esperanto,"
   Professor Frederick Lutz, Albion College.
3. Schiller and Goethe,
   Dr. Ewald Boucke, University of Michigan.
4. The Lyrism of Heine,
   Dr. Carl E. Eggert, University of Michigan.
5. The Pedagogical Ideals of Herder,
   Mr. James A. Campbell, University of Michigan.

CONFERENCE OF RHETORIC AND ENGLISH COMPOSITION

Friday Afternoon

1. Informal Talk, "On the Value of Making Things Unpleasant in Education,"
   Professor F. N. Scott, University of Michigan.
2. Topics for Discussion:
   (a) What parts or features of instruction in English composition have been found to be a waste of time?
   (b) To what extent, and in what particulars, is the correction of Essays effective?
   (c) Should Composition Work be suspended during any part of the High School course?
   (d) How much of Rhetorical Theory is indispensable in Secondary Instruction?

PAID UP MEMBERS OF THE CLUB FOR THE LAST THREE OR MORE CONSECUTIVE YEARS

Atkins, Edith Emma ....Lansing
Austin, E. Jane..........Detroit Central
Arbury, F. W...................Detroit
Adams, C. F............Detroit Central
Angell, J. B.................University
Arbaugh, W. B...............Ypsilanti
Allison, Clara J................Hastings
Beman, W. W................University
Bishop, Harriette A......Detroit Central
Boyer, C. J..................Chicago, Ill.
Buell, Bertha G...............Ypsilanti
Ballard, Edna L.................Owosso
Breed, Gertrude..............Ann Arbor
Bemis, C. L.........................Ionia
Barbour, F. A..........Normal College
Cooke, C. S.............Detroit Central
Critenden, A. R..........Olivet College
Curtis, A. E........................Adrian
Carhart, H. S. ....University
Chamberlain, A. W.............Hastings
Chute, H. N..................Ann Arbor
Coburn, W. G..................Battle Creek
Curtis, G. H........................Gaylord
Cook, Webster...........Saginaw, E. S.
Clemans, E. A...........Detroit Central
D'Ooge, B. L........Mich. State Normal
Davis, J. B.............Detroit Central
Diekhoff, Tobias ....University
Dow, E. W..................University
Everett, J. P.............Mt. Clemens
Essery, E. E...................Manchester
Frost, J. M...................Muskegon
Fox, J. E.................Three Rivers
Green, Loa.....................Big Rapids
Gallup, E. A.................Ann Arbor
Garwood, R. S.................Marshall
Goddard, Mary A....Mich. State Normal
Goodrich, F. S............Albion College
Gass, O. M..............North Branch
Gold, Mary..........................Flint
Halsey, L. R. ....Chicago, Ill.
Hawkes, W. H...............Ann Arbor
Hull, Isabella H.........Detroit Central
Hudson, Richard...............University
Hartbeck, Flora H............Tecumseh
Hartwell, S. O...............Kalamazoo
Harris, J. H....................Pontiac
Hickey, T. P................Battle Creek
Isbell, W. N..................Plymouth
Irwin, F. C.............Detroit Central
Jocelyn, L. P...............Ann Arbor
Jones, L. H.........Mich. State Normal
Jamison, Clara O................Lansing
Kelsey, F. W.................University
Lyons, D. F.....................Fenton
Laird, S. B..........Mich. State Normal
Lewis, W. F...............Port Huron
Lyman, E. A........Mich. State Normal
Lee, L. B................Oak Park, Ill.
Mays, V. G.......................Albion
Montgomery, Jabez..........Ann Arbor
Markley, J. L. ....University
Miner, Mary L. ....Detroit Eastern
Magers, S. D. ....Mich. State Normal
McElroy, E. M. ....Three Rivers
Nutt, H. D................Chicago, Ill.
Peet, B. W..........Mich. State Normal
Porter, Alice................Ann Arbor
Putnam, Daniel......Mich. State Normal
Plaine, Lillian W.........Detroit Central
Palmer, E. D.................St. Johns
Pettee, Edith E..........Detroit Eastern
Parmelee, L. S. ....Flint
Putnam, R. R. ....Detroit Eastern
Rebec, George ....University
Randall, H. M................University
Ross, DeForest...................Ypsilanti
Swain, G. R.....................Bay City
Springer, D. W..............Ann Arbor
Slauson, H. M..............Ann Arbor
Snyder, J. L..........Mich. Agr. College
Stone, J. C..........Mich. State Normal
Strong, E. A.........Mich. State Normal
Volland, A. J. ....Grand Rapids
Wines, L. D.................Ann Arbor
Warriner, E. C. ....Saginaw, E. S.
Whedon, Sara ....Ann Arbor
Wentworth, W. H..............Fremont
Watkins, E. D......................Ithica
Whitney, W. L ....Saginaw, E. S.
Winter, O. B.....................Albion
Waldo, D. B...........Western Normal

Paid up Members of the Club for 1906

Austin, E. Jane..........Detroit Central
Atkins, Edith E....................Lansing
Arbury, F. W....................Detroit
Adams, C. F............Detroit Central
Angell, J. B..................University
Arbaugh, W. B...............Ypsilanti
Allison, Clara J...............Hastings
Appleton, J. Estelle...........Muskegon
Atkinson, H. R..............Battle Creek
Armstrong, Mary E..............Lapeer
Ackerman, F. W............Union City
Bliss, F. L.....Detroit University School

Beman, W. W................University
Bailey, Susan R..............Port Huron
Bishop, Harriette A.......Detroit Central
Bronson, C. M................Toledo, O.
Bromley, Lillian May.....Detroit Central
Bates, F. O...............Detroit Central
Boyer, C. J.................Chicago, Ill.
Buell, Bertha G......Mich. State Normal
Ballard, Edna L.................Owosso
Breed, Gertrude.............Ann Arbor
Bemis, C. L........................Ionia
Barbour, F. A. ....Normal College
Bartlett, A. E............Detroit Central
Beddow, I. A.............Olivet College
Bishop, J. R.............Detroit Eastern
Burnham, Ernest........Western Normal
Bishop, W. R. T................Holland
Bradshaw, J. W..............University
Brown, Alma.....................Lowell
Brosnan, C. J.......................Ovid
Brush, H. R................Hope College
Bannister, Nina ....Monroe
Berry, J. K. M.................Ypsilanti
Bird, J. B.....................University
Blair, Harold ....Monroe
Bower, E. L......................Sturgis
Brown, J. W. C....................Colon
Butler, L. G........................Caro
Bailey, Grace V..................Howell
Bricker, J. I..............Saginaw, W. S.
Biker, N. B..............Saginaw, W. S.
Bennett, Ella ....Ann Arbor
Curtis, A. E. ....Adrian
Carhart, H. S.................University
Chamberlain, A. W. ....Hastings
Chute, H. N..................Ann Arbor
Coburn, W. G..............Battle Creek
Collins, C. I...................Corunna
Cooke, C S.............Detroit Central
Critenden, A. R...........Olivet College
Curtis, G. H...................Gaylord
Curtis, H. L.........Mich. Agr. College
Canfield, A. G.................University
Cross, A. L...................University
Cook, Webster...........Saginaw, E. S.
Clemans, E. A...........Detroit Central
Crane, Mrs. S. A.............Port Huron
Carpenter, C. D............Mansfield, O.
Chase, Clara...............Mt. Pleasant
Chase, Lulu B................Ludington
Clancy, D. G..................Charlotte
Conkling, W. E...............Dowagiac
Coy, Jennie M....................Jackson
Cummings, Edna D...........Cassopolis
Curtis, Mayme ....Chelsea
Camp, Mary F...........Detroit Central
D'Ooge, B. L........Mich. State Normal
Drake, J. H...................University
D'Ooge, M. L..................University
Darnell, Albertus.........Detroit Central
Davis, J. B.............Detroit Central
Diekhoff, Tobias..............University
Dow, E. W...................University
Doty, Helen..............Three Rivers
Dudley, S. M.....................Monroe
Daley, H. C. ....Hudson
Dennis, Leone B..............Marcellus
Davis, Julia A.......................Ionia
Dennis, P. E..............Harbor Beach
Derr, Homer ....Mt. Pleasant
Dewey, G. R.............Grand Rapids
De Witt, A. D.................St. Louis
Doty, Jessie R......................Alma
Duthie, May A.............Grand Rapids
Everett, J P...............Mt. Clemens
Easton, A. J................Port Huron
Essery, E. E................Manchester
Ellsworth, F. E.....................Alma
Escott, E. B..................University
Elliott, H. M...................Petoskey
Elliott, Lucy ....Detroit Eastern
Ford, R. C..........Mich. State Normal
Frost, H. H.............Detroit Central
Fullerton, Fred...................Mason
Frost, J. M....................Muskegon
Fox, J. E..................Three Rivers
Fales, Edith G....................Detroit
Farmer, Sara L..........Benton Harbor
Ferguson, Fred...............Northville
Fyan, Lila E................Port Huron
Forsythe, L. L..............Mt. Clemens
Green, Loa ....Big Rapids
Gallup, E. A.................Ann Arbor
Garwood, R. S.................Marshall
Gee, E. F..........................Wayne
Goddard, Mary A...Mich. State Normal
Goodrich, F. S............Albion College
Gass, O. M...............North Branch
Gold, Mary..........................Flint
Gould, R. R. N...............Kalamazoo
Grawn, C. T............Central Normal
Green, C. W.............Albion College
Goodfellow, Theodore........Royal Oak
Goldsmith, J. D..........Benton Harbor
Gregg, Ethel ....Detroit Central
Geiser, J. M..................Cassopolis
Gold, Lillian ....Flint
Goldman, Miriam.........Detroit Central
Green, C. W.....................Ypsilanti
Gurd, Edith..............Benton Harbor
Hulst, Caroline S..........Grand Rapids
Halsey, L. R................Battle Creek
Hawkes, W. H................Ann Arbor
Hull, Isabella H..........Detroit Central
Hull, L. C...................Orchard Lake
Hudson, Richard...............University
Harvey, S. B....................Hillsdale
Hoyt, C. O...........Mich. State Normal
Hartbeck, Flora ....Tecumseh
Hartwell, S. O................Kalamazoo
Harris, J. H. ....Pontiac
Hickey, T. P. ....Battle Creek
Howes, Mary F................Plymouth
Harvey, N. A........Mich. State Normal
Hard, H. A.......................Bay City
Harper, Susan............Detroit Central

Hill, Grace A. .... Detroit
Hornberger, J. J. .... Northville
Hedden, Mary E. .... Pontiac
Hine, Katherine G................ Detroit
Hollister, R. D. T.............. University
Humphrey, Carolyn............ Muskegon
Hamilton, Mina................. E. Tawas
Heeson, Miss M G............. Cassopolis
Hendrick, H. B.............. Marine City
Hughes, Clara.................. Saginaw
Hendrick, E. L................. St. Joseph
Isbell, W. N.................... Plymouth
Irwin, F. C............... Detroit Central
Isherwood, Maude A....... Grand Haven
Jocelyn, L. P. .... Ann Arbor
Jennings, Albert............ Grand Rapids
Jones, L. H.......... Mich. State Normal
Jamison, Clara O................ Lansing
Josselyn, H. W........... Detroit Central
Jensen, Frank.................. Ypsilanti
Jerome, N. B...................... Evart
Kelsey, F. W................... University
Kirchhoffer, Marie........... Manchester
Ketcham, J. C................... Hastings
Kittell, E. C....................... Orion
Kirk, R. R...................... University
Kaiser, Grace............... Mt. Clemens
Kanouse, Sarah L................ Howell
King, Helen B. .... Saginaw, E. S.
Karpinski, L. C. .... University
Keeney, Flora S. .... Flint
Kempf, Flora.................... Chelsea
Kimball, Edith M........ Detroit Eastern
Kinnaman, J. O........... Benton Harbor
Krenerick, H. C.............. Berwyn, Ill.
Lyons, D. F....................... Fenton
Laird, S. B.......... Mich. State Normal
Lewis, W. F.................. Port Huron
Lyman, E. A. .... Mich. State Normal
Lyster, W. S...................... Vassar
Levenworth, W. S......... Olivet College
Lee, L. B................... Oak Park, Ill.
Longman, M. W.................. Otsego
Lindsay, G. A..................... Detroit
Lynch, Abigail....... Mich. State Normal
Larned, Frances.................. Otsego
Lancaster, E. G............ Olivet College
Loomis, F. H.............. Grand Rapids
Lutz, Frederick............ Albion College
Lee, W. L...................... Richmond
Mays, V. G....................... Albion
Morrill, C. B.................. University
Montgomery, Jabez........... Ann Arbor
Markley, J. L.................. University
Miner, Mary L........... Detroit Eastern
Magers, S. D........ Mich. State Normal
Marckwardt, O. C.......... Grand Rapids
Marshall, J. J.................... Romeo
Mann, L. V.................. Port Huron
Miles, O. M..................... Hudson
Matthews, J. W.......... Detroit Western
Markham, H. A.............. Marine City
Marsh, E. O..................... Jackson

Michens, C. N. .... Adrian
Maul, E. G.................... Muskegon
Mautner, Gertrude B...... Saginaw, E. S.
Morrison, W. J.................... Holly
Mast, J. O................ Hope College
Moffatt, W. E.........................
Meyers, F. E. .... Hillsdale
McLaughlin, A. C............. University
McElroy, E. M............ Three Rivers
McDiarmid, L. A.................. Albion
McManis, J. T. .... Western Normal
Mackenzie, David........ Detroit Central
Mackintosh, J. J............. Mt. Clemens
MacDuff, Douglas.......... Orchard Lake
McGee, G. A.................... Cadillac
McMillan, D. W.................. Detroit
McFadzean, Kate E......... Port Huron
Nutt, H. D................... Chicago, Ill.
Norris, O. O......... Mich. State Normal
Nykerk, J. B............... Hope College
Nash, Mabel E................. Hillsdale
Noble, Marjorie............... Toledo, O.
Osgerby, J. K..................... Howell
Olcutt, Amelia F.............. Bessemer
Osburne, M. E.................. Lansing
Peet, B. W.......... Mich. State Normal
Porter, Alice.................. Ann Arbor
Putnam, Daniel...... Mich. State Normal
Paine, Llian W.......... Detroit Central
Palmer, E. D................... St. Johns
Patterson, G. W.............. University
Pettee, Edith E.......... Detroit Eastern
Putnam, Mary B..... Mich. State Normal
Parrott, L. M. .... Saginaw, E. S.
Parmelee, L. S..................... Flint
Putnam, R. R............ Detroit Eastern
Peckham, Harriet L............. Hastings
Phelps, Nancy........... Detroit Western
Parker, Caroline.......... Detroit Central
Pattingill, H. R................... Lansing
Parsons, Maude............. Battle Creek
Roberts, D .H....... Mich. State Normal
Rebec, George................ University
Randall, H. M................. University
Ross, DeForest................. Ypsilanti
Reynolds, E. P..................... Evart
Rivett, B. J....................... Homer
Reinhold, Robert............... Ypsilanti
Reynolds, Miss C. W........... Jackson
Ryder, E. H........... Mich. Agr. College
Rothman, Alice............... Ann Arbor
Reed, J. L........................ Howell
Paine, Lillian W.......... Detroit Central
Swain, G. R.................... Bay City
Springer, D. W............... Ann Arbor
Smith, N. F....................... Olivet
Smith, G. D................... Ludington
Slauson, H. M................ Ann Arbor
Sloan, N. B...................... Lansing
Snyder, J. L.......... Mich. Agr. College
Stone, J. C.......... Mich. State Normal
Strong, E. A......... Mich. State Normal
Stewart, J. A.................... Bay City

Stett, A. C	Marlette
Smith, Cyrus	Lansing
Sharpe, E. M	Bay City
Stearns, Frances L	Adrian
Sturgis, Martha	Ann Arbor
Seymour, Emily	Evart
Shaw, Ellen	Vassar
Sexton, J. M	Fenton
Schiller, J. D	Niles
Schmitz, Ernest	Detroit
Sloan, Lucy A	Central Normal
Sterling, W. D	Lansing
Stevenson, Carlie	Muskegon
Struble, R. H	Detroit
Sprague, R. M	Douglas
Shigley, A. B	Hart
Spaulding, F. B.	Chicago, Ill.
Snell, Ida L	Vassar
Smith, Frank	West Toledo, O.
Turner, A. L	Saline
Thatcher, W. F. G	Jackson
Tabor, C. F	Orchard Lake
Thomas, J. M	University
Thompson, E. C	Detroit
Thomas, Miss J. L	Detroit
Tice, Ethel	Cassopolis
Trochael, W. J	Lansing
Travis, Ora	Union City
True, Myra B	Adrian
Volland, A. J	Grand Rapids
Vernor, Annie	Hillsdale
Wines, L. D	Ann Arbor
Warriner, E. C	Saginaw, E. S.
Whedon, Sara	Ann Arbor
Wilson, E. J	St. Johns
Winkler, Max	University
Wentforth, W. H	Fremont
Warner, W. W.	Saginaw, E. S.
Watkins, E. D	Ithica
Williams, C. B	Kalamazoo College
Whitney, W. L	Saginaw, E. S.
Wright, L. L	Ironwood
Winter, O. B	Albion
Waldo, D. B	Western Normal
Whitney, A. S	University
Wade, C. J	Flint
Washburn, E. R	Dexter
Wagner, J. L	Charlotte
Wright, W. R	Benton Harbor
Worden, J. P	Kalamazoo
Wheeler, F. J	Ypsilanti
Wagner, T. E	Delray
Watkins, P. H	Ithica
West, E. D	Adrian
Whitney, Edward	Reed City
Whittaker, C. C	Orchard Lake
Wilbur, Etta	Lansing
Willison, Mabel C	Decatur
Winter, John E	Ann Arbor
Wood, Leslie	Western Normal
Worth, C. N	Kalamazoo
Ziwet, Alexander	University
Zahner, Elizabeth	Saginaw, E. S.
Zimmerman, Marie	Saginaw